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**Lee et al.**

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(54) **COMPOUND FOR ORGANIC ELECTRIC ELEMENT, ORGANIC ELECTRIC ELEMENT USING SAME, AND ELECTRONIC DEVICE THEREOF**

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(58) **Field of Classification Search**

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See application file for complete search history.

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(57) **ABSTRACT**

Provided are an organic electric element for achieving high light-emitting efficiency, low driving voltage and improved lifespan, which comprises a mixture of a compound of Formula (1) and a compound of Formula (2) as a phosphorescent host material; and an electronic device thereof.

**20 Claims, 1 Drawing Sheet**

- (51) **Int. Cl.**  
*C07D 403/10* (2006.01)  
*H01L 51/50* (2006.01)

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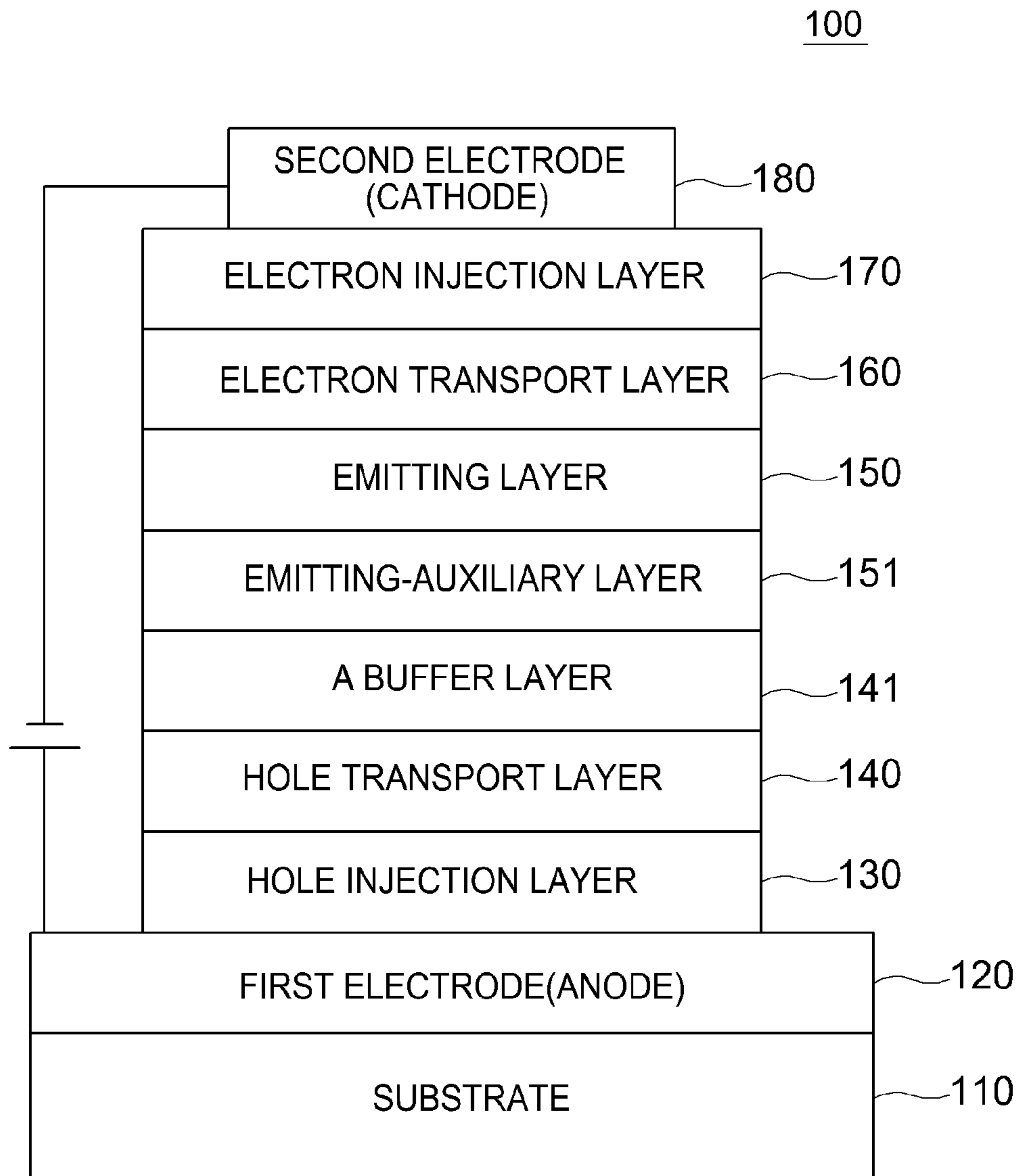
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**COMPOUND FOR ORGANIC ELECTRIC  
ELEMENT, ORGANIC ELECTRIC ELEMENT  
USING SAME, AND ELECTRONIC DEVICE  
THEREOF**

BACKGROUND

Technical Field

The present invention relates to compound for organic electronic element, organic electronic element using the same, and an electronic device thereof.

Background Art

In general, organic light emitting phenomenon refers to a phenomenon that converts electronic energy into light energy by using an organic material. An organic electronic element using an organic light emitting phenomenon usually has a structure including an anode, a cathode, and an organic material layer interposed therebetween. Here, in order to increase the efficiency and stability of the organic electronic element, the organic material layer is often composed of a multi-layered structure composed of different materials, and for example, may include a hole injection layer, a hole transport layer, an emitting layer, an electron transport layer, an electron injection layer and the like.

A material used as an organic material layer in an organic electronic element may be classified into a light emitting material and a charge transport material, such as a hole injection material, a hole transport material, an electron transport material, an electron injection material and the like depending on its function.

In the case of a polycyclic compound containing a heteroatom, the difference in properties according to the material structure is so large that it is applied to various layers as a material of an organic electronic element. In particular, it has characteristics of different band gaps (HOMO, LUMO), electrical characteristics, chemical properties, and physical properties depending on the number of rings, fused positions and the type and arrangement of heteroatoms, therefore application development for layers of various organic electronic elements using the same has been progressed.

As a representative example thereof, in the following Patent Documents 1 to 4, the performance of the 5-membered cyclic compound in the polycyclic compound has been reported depending on the hetero type, arrangement, substituent type, fused position, and the like.

[Patent Document 1]: U.S. Pat. No. 5,843,607

[Patent Document 2]: Japanese Laid-Open Patent Publication No. 1999-162650

[Patent Document 3]: Korean Published Patent Application No. 2008-0085000

[Patent Document 4]: US Patent Publication No. 2010-0187977

[Patent Document 5]: Korean Published Patent Application No. 2011-0018340

[Patent Document 6]: Korean Published Patent Application No. 2009-0057711

Patent Documents 1 and 2 disclose an embodiment in which the indolecarbazole core in which the hetero atom in the 5-membered cyclic compound is composed only of nitrogen (N) is used, and an aryl group substituted or unsubstituted in N of indolecarbazole is used. However, in the prior invention 1, there exists only a simple aryl group substituted or unsubstituted with an alkyl group, an amino

group, an alkoxy group, or the like as a substituent, so that the effect of the substituents of the polycyclic compounds was very poor to prove, and only the use as a hole transport material is described, and the use thereof as a phosphorescent host material is not described.

Patent Documents 3 and 4 disclose a compound in which pyridine, pyrimidine, triazine or the like containing an aryl group and N, respectively, were substituted for an indolecarbazole core having a hetero atom N in the same 5-membered cyclic compound as in the above Patent Documents 1 and 2, however only the use examples for phosphorescent green host materials are described, and the performance for other heterocyclic compounds substituted for indolecarbazole core is not described.

In Patent Documents 5, Nitrogen (N), oxygen (O), sulfur (S), carbon and the like are described as heteroatom in the 5-membered cyclic compound, however there are only examples using the same heteroatom in the performance measurement data, the performance characteristics of a 5-membered cyclic compound containing a different heteroatom could not be confirmed.

Therefore, the patent document does not disclose solutions to low charge carrier mobility and low oxidation stability of a 5-membered cyclic compound containing same heteroatom.

When the 5-membered cyclic compound molecules are generally laminated, as the adjacent  $\pi$ -electrons increase, they have a strong electrical interaction, and this is closely related to the charge carrier mobility, particularly, the same 5-membered cyclic compound of N—N type has an edge-to-face morphology as an order of arrangement of molecules when molecules are laminated, otherwise a different 5-membered cyclic compound with different heteroatoms has an antiparallel cofacial  $\pi$ -stacking structure in which the packing structure of the molecules is opposite to each other, so that the arrangement order of the molecules becomes face-to-face morphology. It is reported that the steric effect of the substituent substituted on the asymmetrically arranged hetero atom N as the cause of this laminated structure causes relatively high carrier mobility and high oxidation stability (*Org. Lett.* 2008, 10, 1199).

In Patent Document 6, an example of using as a fluorescent host material for various polycyclic compounds having 7 or more membered cyclic compounds has been reported.

As described above, the fused positions, the number of rings, the arrangement of heteroatoms, and characteristic change by type of the polycyclic compounds have not yet been sufficiently developed.

Particularly, in a phosphorescent organic electronic element using a phosphorescent dopant material, the LUMO and HOMO levels of the host material have a great influence on the efficiency and life span of the organic electronic element, this is because the charge balance control in the emitting layer, the quenching of the dopant, and the reduction in efficiency and life span due to light emission at the interface of the hole transport layer can be prevented, depending on whether electron and hole injection in the emitting layer can be efficiently controlled.

For fluorescent and phosphorescent host materials, recently we have been studying the increase of efficiency and life span of organic electronic elements using TADF (thermal activated delayed fluorescent), exciplex, etc., particularly, and many studies have been carried out to identify the energy transfer method from the host material to the dopant material.

Although there are various methods for identifying the energy transfer in the emitting layer for TADF (thermally

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activated delayed fluorescent) and exciplex, it can be easily confirmed by the PL lifetime (TRTP) measurement method.

The TRTP (Time Resolved Transient PL) measurement method is a method of observing a decay time over time after irradiating the host thin film with a pulsed light source, and therefore it is possible to identify the energy transfer method by observing the energy transfer and the lag time. The TRTP measurement can distinguish between fluorescence and phosphorescence, an energy transfer method in a mixed host material, an exciplex energy transfer method, and a TADF energy transfer method.

There are various factors affecting the efficiency and life span depending on the manner in which the energy is transferred from the host material to the dopant material, and the energy transfer method differs depending on the material, so that the development of stable and efficient host material for organic electronic element has not yet been sufficiently developed. Therefore, development of new materials is continuously required, and especially development of a host material for an emitting layer is urgently required.

### DETAILED DESCRIPTION OF THE INVENTION

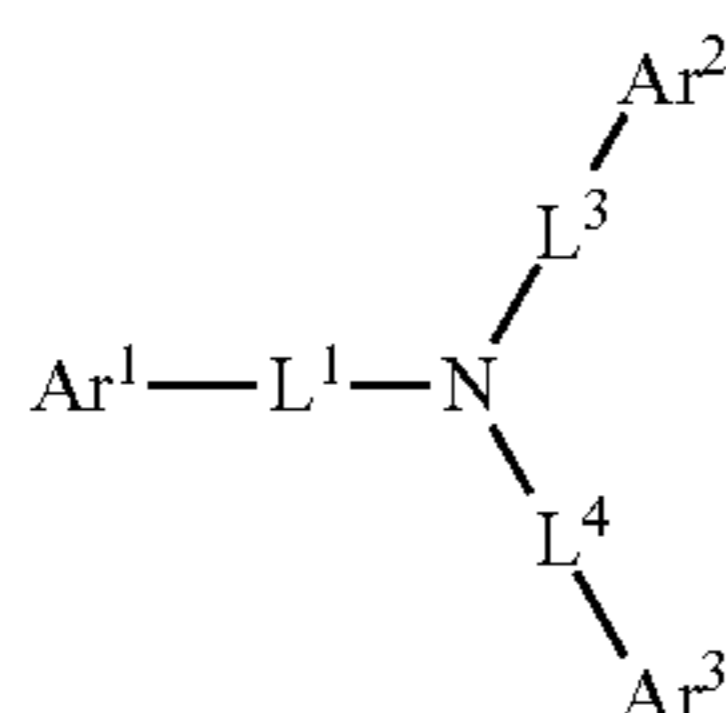
#### Summary

The present invention has been proposed in order to solve the problems of the phosphorescent host material, and an object of the present invention is, by controlling the HOMO level of a host material of a phosphorescent emitting organic electronic element including a phosphorescent dopant, to provide a compound capable of controlling charge balance and of improving efficiency and life span in an emitting layer, and an organic electronic element using the same and an electronic device thereof.

#### Technical Solution

In order to control the efficient hole injection in the emitting layer of the phosphorescence emitting organic electronic element, by containing a specific second host material in combination with a specific first host material as a main component, it is possible to reduce the energy barrier of the emitting layer and the adjacent layer, the charge balance in the emitting layer is maximized, thereby providing high efficiency and high life of the organic electronic device.

The present invention provides an organic electronic element comprising a first electrode, a second electrode, and an organic material layer formed between the first electrode and the second electrode, wherein the organic material layer includes an emitting layer, wherein the emitting layer includes a first host compound represented by the following Formula (1) and a second host compound represented by the following Formula (2).

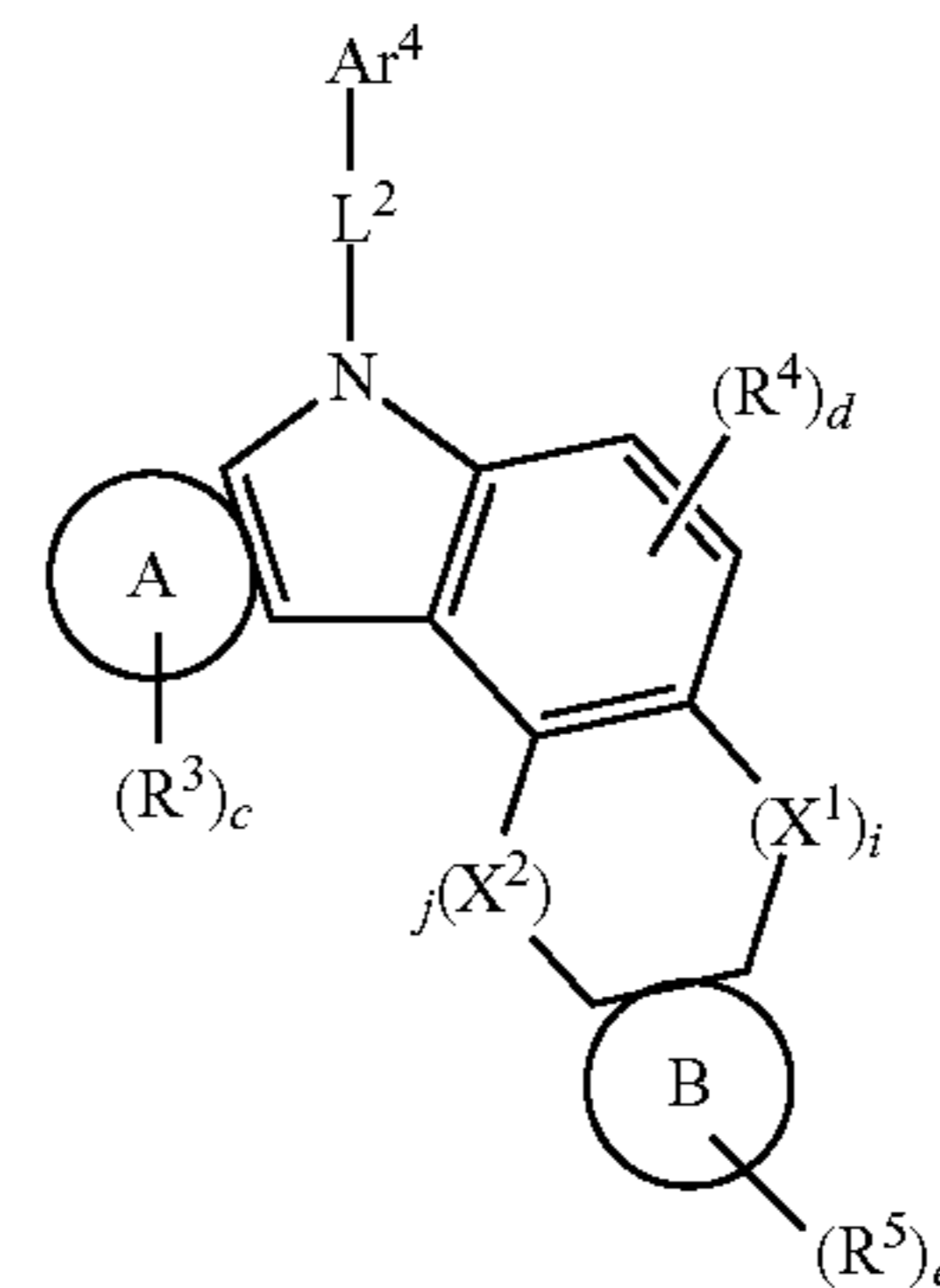


Formula (1)

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-continued

Formula (2)



The present invention also provides an organic electronic element using the compound represented by the above Formulas and an electronic device thereof.

#### Effects of the Invention

By using the mixture according to the present invention as a phosphorescent host material, it is possible to achieve a high luminous efficiency and a low driving voltage of an organic electric element, and the life span of the device can be greatly improved.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The FIGURE an illustration of an organic electroluminescent device according to the present invention.

100: organic electric element,	110: substrate
120: the first electrode (anode),	130: the hole injection layer
140: the hole transport layer,	141: a buffer layer
150: the emitting layer,	151: the emitting auxiliary layer
160: the electron transport layer,	170: the electron injection layer
180: the second electrode (cathode)	

#### DETAILED DESCRIPTION

Hereinafter, some embodiments of the present invention will be described in detail. Further, in the following description of the present invention, a detailed description of known functions and configurations incorporated herein will be omitted when it may make the subject matter of the present invention rather unclear.

In addition, terms, such as first, second, A, B, (a), (b) or the like may be used herein when describing components of the present invention. Each of these terminologies is not used to define an essence, order or sequence of a corresponding component but used merely to distinguish the corresponding component from other component(s). It should be noted that if a component is described as being "connected", "coupled", or "connected" to another component, the component may be directly connected or connected to the other component, but another component may be "connected", "coupled" or "connected" between each component.

As used in the specification and the accompanying claims, unless otherwise stated, the following is the meaning of the term as follows.

Unless otherwise stated, the term "halo" or "halogen", as used herein, includes fluorine, bromine, chlorine, or iodine.

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Unless otherwise stated, the term “alkyl” or “alkyl group”, as used herein, has a single bond of 1 to 60 carbon atoms, and means saturated aliphatic functional radicals including a linear alkyl group, a branched chain alkyl group, a cycloalkyl group (alicyclic), an cycloalkyl group substituted with a alkyl or an alkyl group substituted with a cycloalkyl.

Unless otherwise stated, the term “haloalkyl” or “halogen alkyl”, as used herein, includes an alkyl group substituted with a halogen.

Unless otherwise stated, the term “heteroalkyl”, as used herein, means alkyl substituted one or more of carbon atoms consisting of an alkyl with hetero atom.

Unless otherwise stated, the term “alkenyl” or “alkynyl”, as used herein, has double or triple bonds of 2 to 60 carbon atoms, but is not limited thereto, and includes a linear or a branched chain group.

Unless otherwise stated, the term “cycloalkyl”, as used herein, means alkyl forming a ring having 3 to 60 carbon atoms, but is not limited thereto.

Unless otherwise stated, the term “alkoxyl group”, “alkoxy group” or “alkyloxy group”, as used herein, means an oxygen radical attached to an alkyl group, but is not limited thereto, and has 1 to 60 carbon atoms.

Unless otherwise stated, the term “alkenoxyl group”, “alkenoxo group”, “alkenyloxyl group” or “alkenyloxo group”, as used herein, means an oxygen radical attached to an alkenyl group, but is not limited thereto, and has 2 to 60 carbon atoms.

Unless otherwise stated, the term “aryloxyl group” or “aryloxy group”, as used herein, means an oxygen radical attached to an aryl group, but is not limited thereto, and has 6 to 60 carbon atoms.

Unless otherwise stated, the term “aryl group” or “arylene group”, as used herein, has 6 to 60 carbon atoms, but is not limited thereto. Herein, the aryl group or arylene group means a monocyclic and polycyclic aromatic group, and may also be formed in conjunction with an adjacent group. Examples of “aryl group” may include a phenyl group, a biphenyl group, a fluorene group, or a spirofluorene group.

The prefix “aryl” or “ar” means a radical substituted with an aryl group. For example, an arylalkyl may be an alkyl substituted with an aryl, and an arylalanyl may be an alkenyl substituted with aryl, and a radical substituted with an aryl has a number of carbon atoms as defined herein.

Also, when prefixes are named subsequently, it means that substituents are listed in the order described first. For example, an arylalkoxy means an alkoxy substituted with an aryl, an alkoxy carbonyl means a carbonyl substituted with an alkoxy, and an arylcarbonylalkenyl also means an alkenyl substituted with an arylcarbonyl, wherein the arylcarbonyl may be a carbonyl substituted with an aryl.

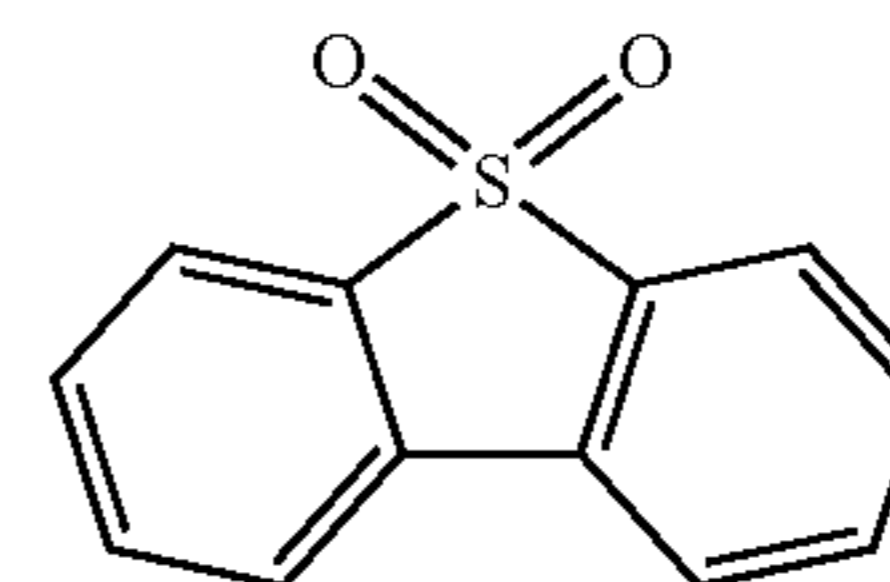
Unless otherwise stated, the term “heteroalkyl”, as used herein, means alkyl containing one or more of hetero atoms. Unless otherwise stated, the term “heteroaryl group” or “heteroarylene group”, as used herein, means a C2 to C60 aryl containing one or more of hetero atoms or arylene group, but is not limited thereto, and includes at least one of monocyclic and polycyclic rings, and may also be formed in conjunction with an adjacent group.

Unless otherwise stated, the term “heterocyclic group”, as used herein, contains one or more heteroatoms, but is not limited thereto, has 2 to 60 carbon atoms, includes any one of monocyclic and polycyclic rings, and may include heteroaliphatic ring and/or heteroaromatic ring. Also, the heterocyclic group may also be formed in conjunction with an

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adjacent group. Unless otherwise stated, the term “heteroatom”, as used herein, represents at least one of N, O, S, P, or Si.

Also, the term “heterocyclic group” may include a ring containing SO<sub>2</sub> instead of carbon consisting of cycle. For example, “heterocyclic group” includes compound below.



Unless otherwise stated, the term “aliphatic”, as used herein, means an aliphatic hydrocarbon having 1 to 60 carbon atoms, and the term “aliphatic ring”, as used herein, means an aliphatic hydrocarbon ring having 3 to 60 carbon atoms.

Unless otherwise stated, the term “ring”, as used herein, means an aliphatic ring having 3 to 60 carbon atoms, or an aromatic ring having 6 to 60 carbon atoms, or a hetero ring having 2 to 60 carbon atoms, or a fused ring formed by the combination of them, and includes a saturated or unsaturated ring.

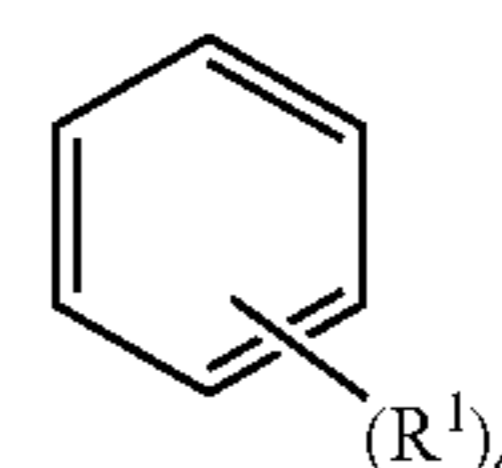
Other hetero compounds or hetero radicals other than the above-mentioned hetero compounds include, but are not limited thereto, one or more heteroatoms.

Unless otherwise stated, the term “carbonyl”, as used herein, is represented by —COR', wherein R' may be hydrogen, an alkyl having 1 to 20 carbon atoms, an aryl having 6 to 30 carbon atoms, a cycloalkyl having 3 to 30 carbon atoms, an alkenyl having 2 to 20 carbon atoms, an alkynyl having 2 to 20 carbon atoms, or the combination of these.

Unless otherwise stated, the term “ether”, as used herein, is represented by —R—O—R', wherein R or R' may be independently hydrogen, an alkyl having 1 to 20 carbon atoms, an aryl having 6 to 30 carbon atoms, a cycloalkyl having 3 to 30 carbon atoms, an alkenyl having 2 to 20 carbon atoms, an alkynyl having 2 to 20 carbon atoms, or the combination of these.

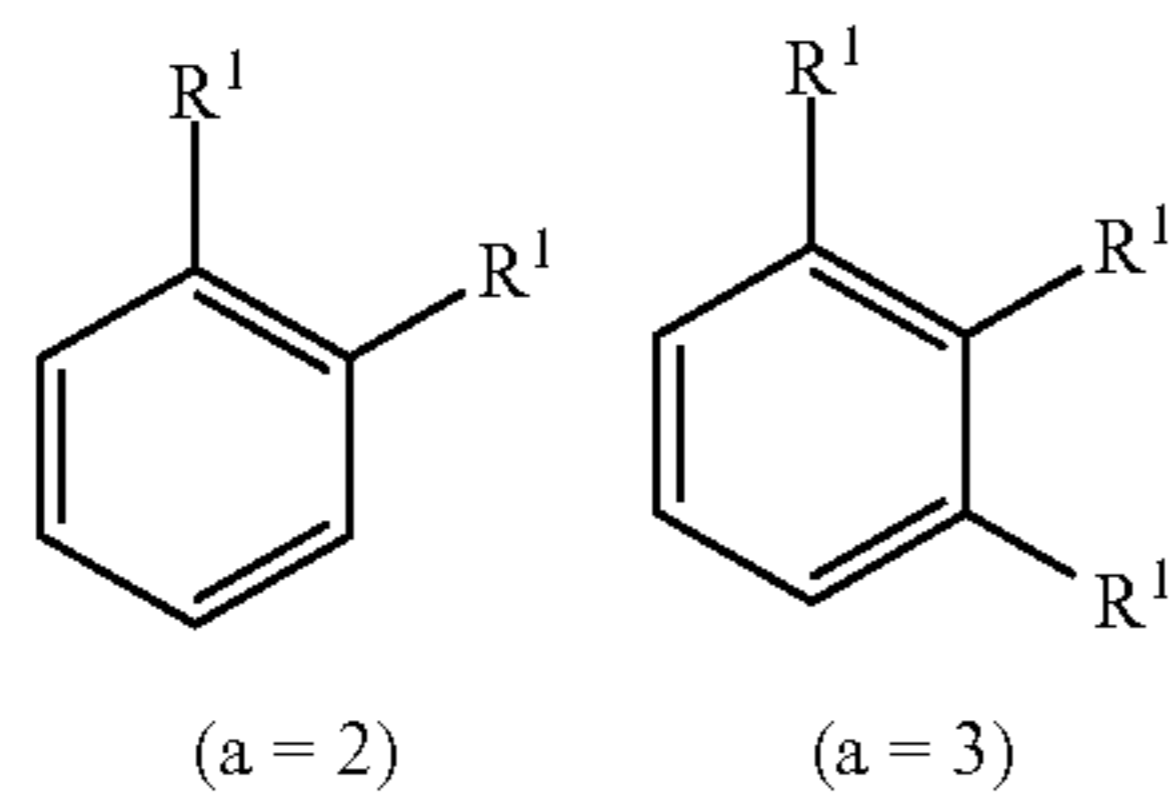
Unless otherwise stated, the term “substituted or unsubstituted”, as used herein, means that substitution is substituted by at least one substituent selected from the group consisting of, but is not limited thereto, deuterium, halogen, an amino group, a nitrile group, a nitro group, a C<sub>1</sub>-C<sub>20</sub> alkyl group, a C<sub>1</sub>-C<sub>20</sub> alkoxy group, a C<sub>1</sub>-C<sub>20</sub> alkylamine group, a C<sub>1</sub>-C<sub>20</sub> alkylthiopen group, a C<sub>6</sub>-C<sub>20</sub> arylthiopen group, a C<sub>2</sub>-C<sub>20</sub> alkenyl group, a C<sub>2</sub>-C<sub>20</sub> alkynyl group, a C<sub>3</sub>-C<sub>20</sub> cycloalkyl group, a C<sub>6</sub>-C<sub>20</sub> aryl group, a C<sub>6</sub>-C<sub>20</sub> aryl group substituted by deuterium, a C<sub>8</sub>-C<sub>20</sub> arylalkenyl group, a silane group, a boron group, a germanium group, and a C<sub>2</sub>-C<sub>20</sub> heterocyclic group.

Unless otherwise expressly stated, the Formula used in the present invention, as used herein, is applied in the same manner as the substituent definition according to the definition of the exponent of the following Formula.



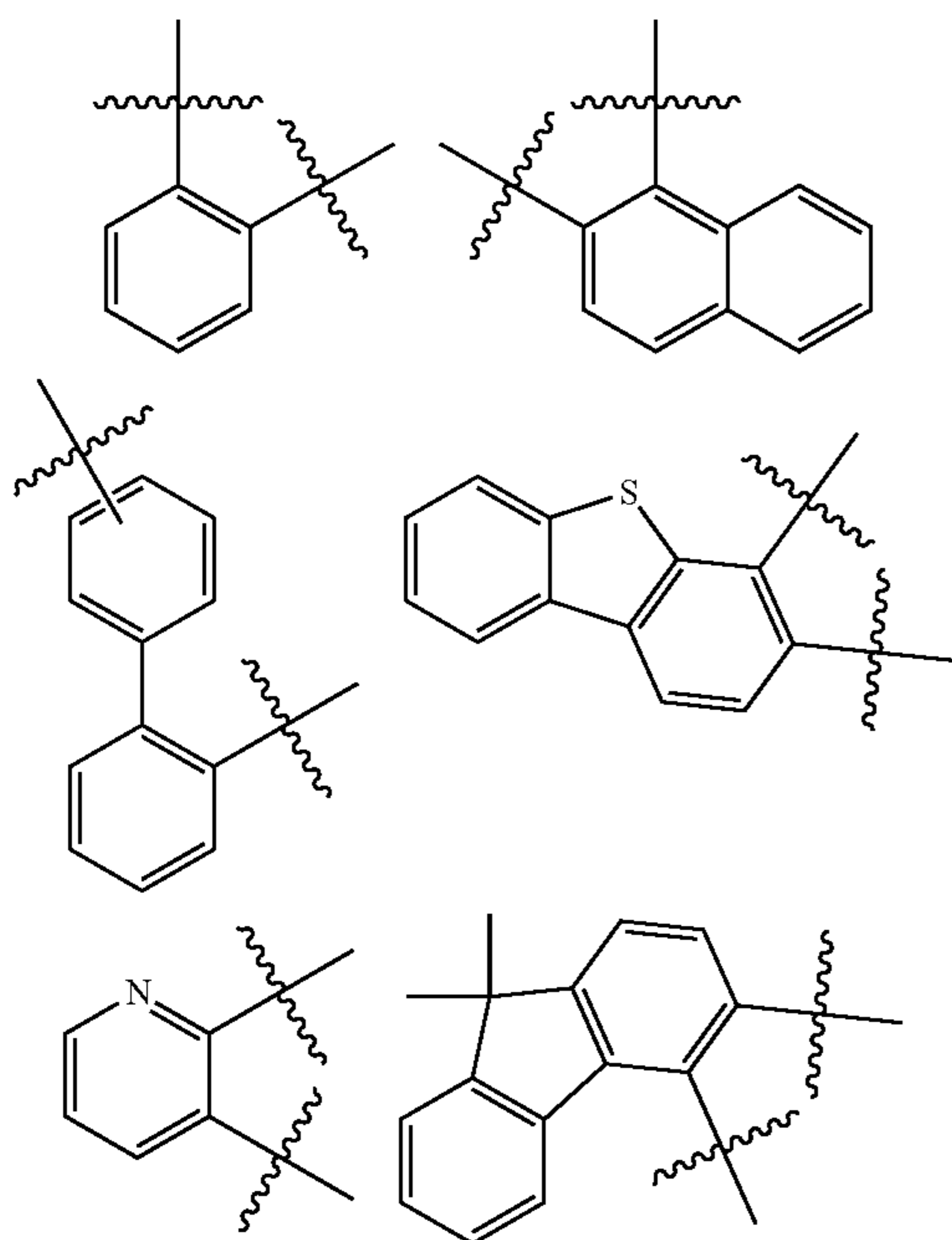
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Wherein, when a is an integer of zero, the substituent  $R^1$  is absent, when a is an integer of 1, the sole substituent  $R^1$  is linked to any one of the carbon constituting the benzene ring, when a is an integer of 2 or 3, they are respectively combined as follows, in which  $R^1$  are the same or different from each other, and when a is an integer of 4 to 6, and it is bonded to the carbon of the benzene ring in a similar manner, whereas the indication of hydrogen bonded to the carbon forming the benzene ring is omitted.



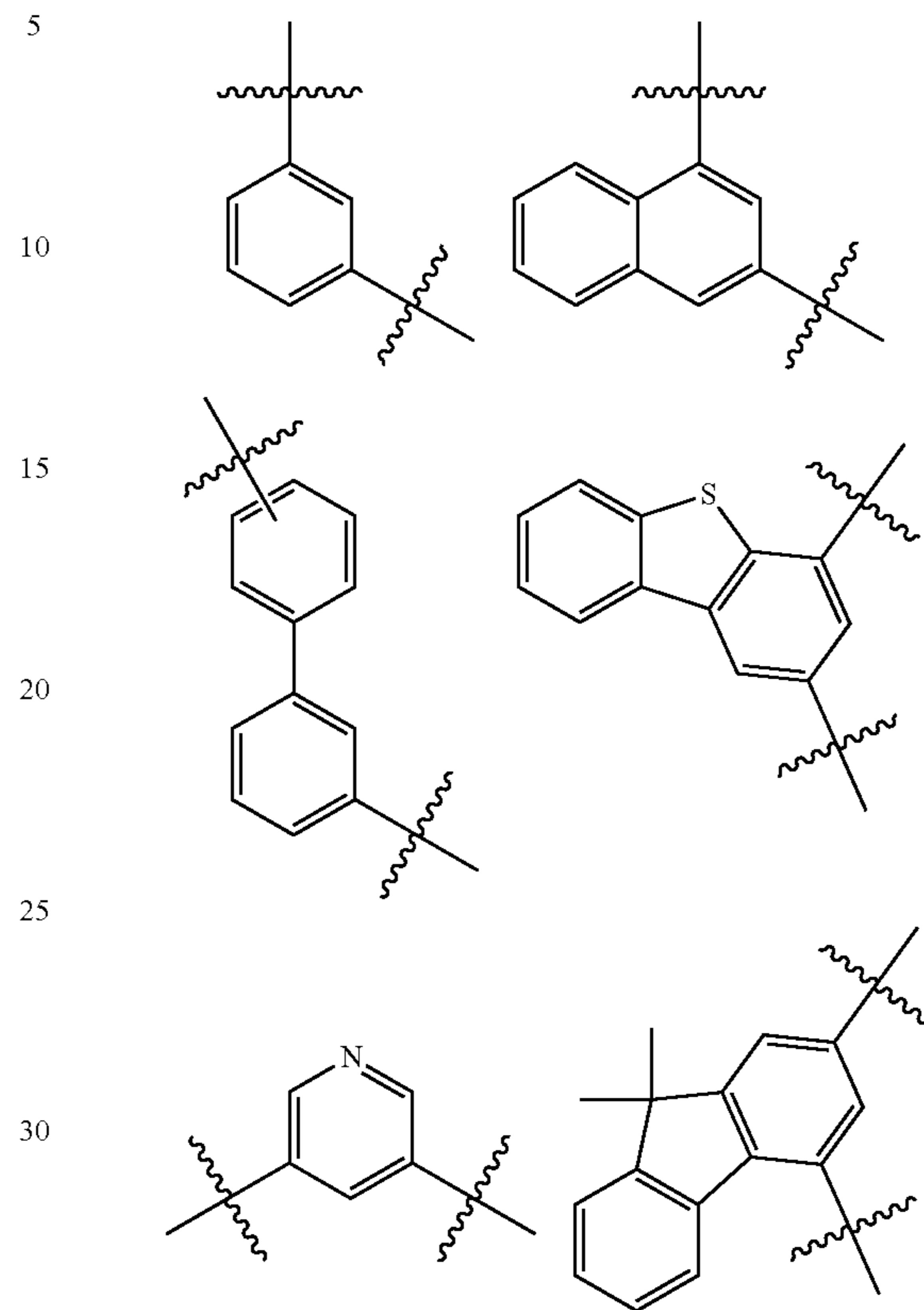
Unless otherwise expressly stated, the terms “ortho”, “meta”, and “para” used in the present invention refer to the substitution positions of all substituents, and the ortho position indicates the position of the substituent immediately adjacent to the compound, for example, when benzene is used, it means 1 or 2 position, and the meta position is the next substitution position of the neighbor substitution position, when benzene as an example stands for 1 or 3 position, and the para position is the next substitution position of the meta position, which means 1 and 4 position when benzene is taken as an example. A more detailed example of the substitution position is as follows, and it can be confirmed that the ortho-, and meta-position are substituted by non-linear type and para-positions are substituted by linear type.

Example of Ortho-Position

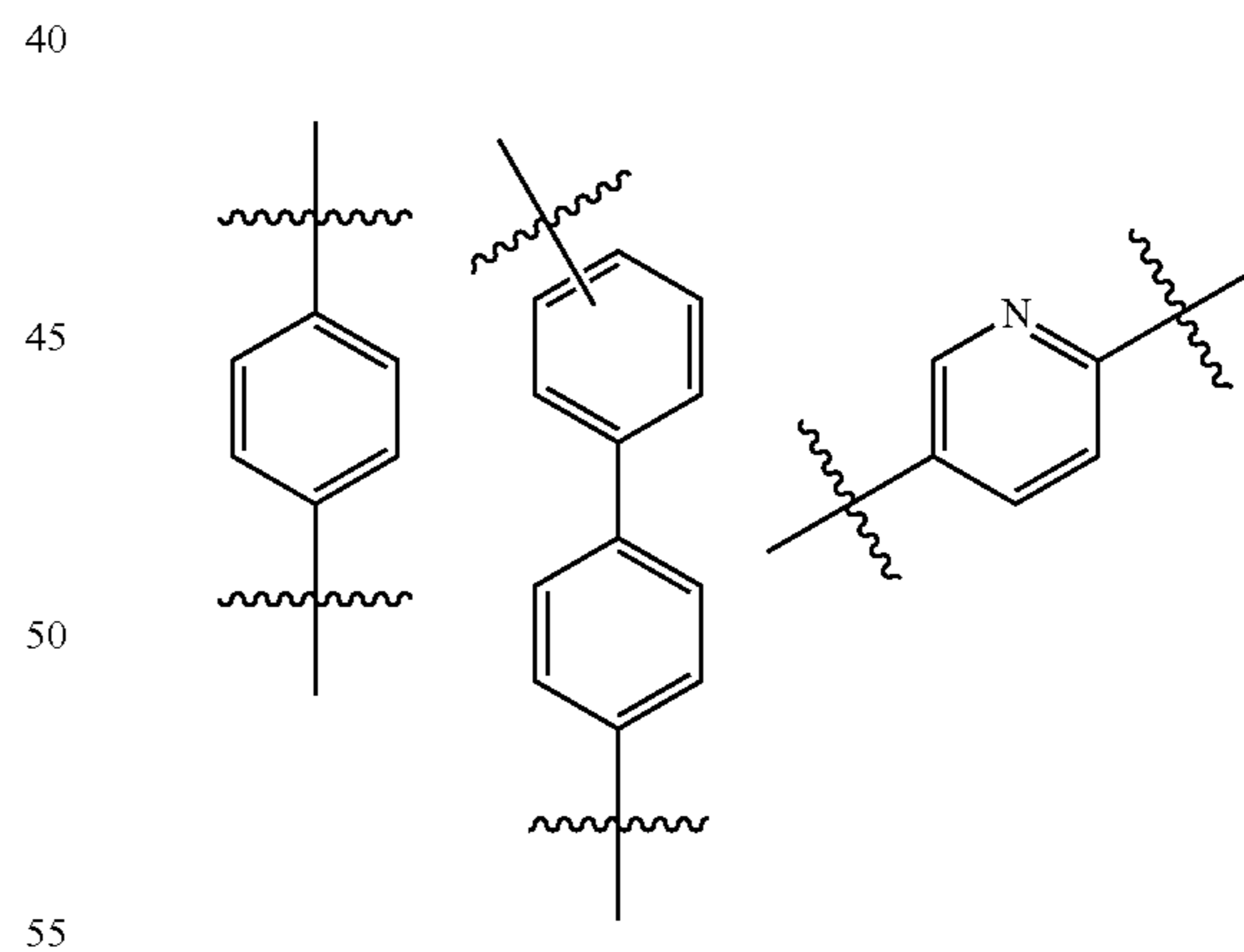


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Example of Meta-Position



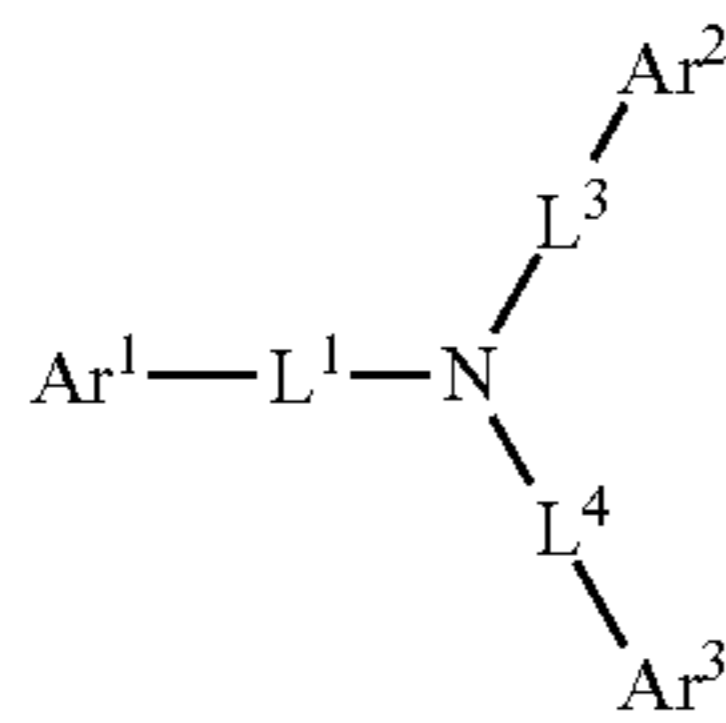
Example of Para-Position



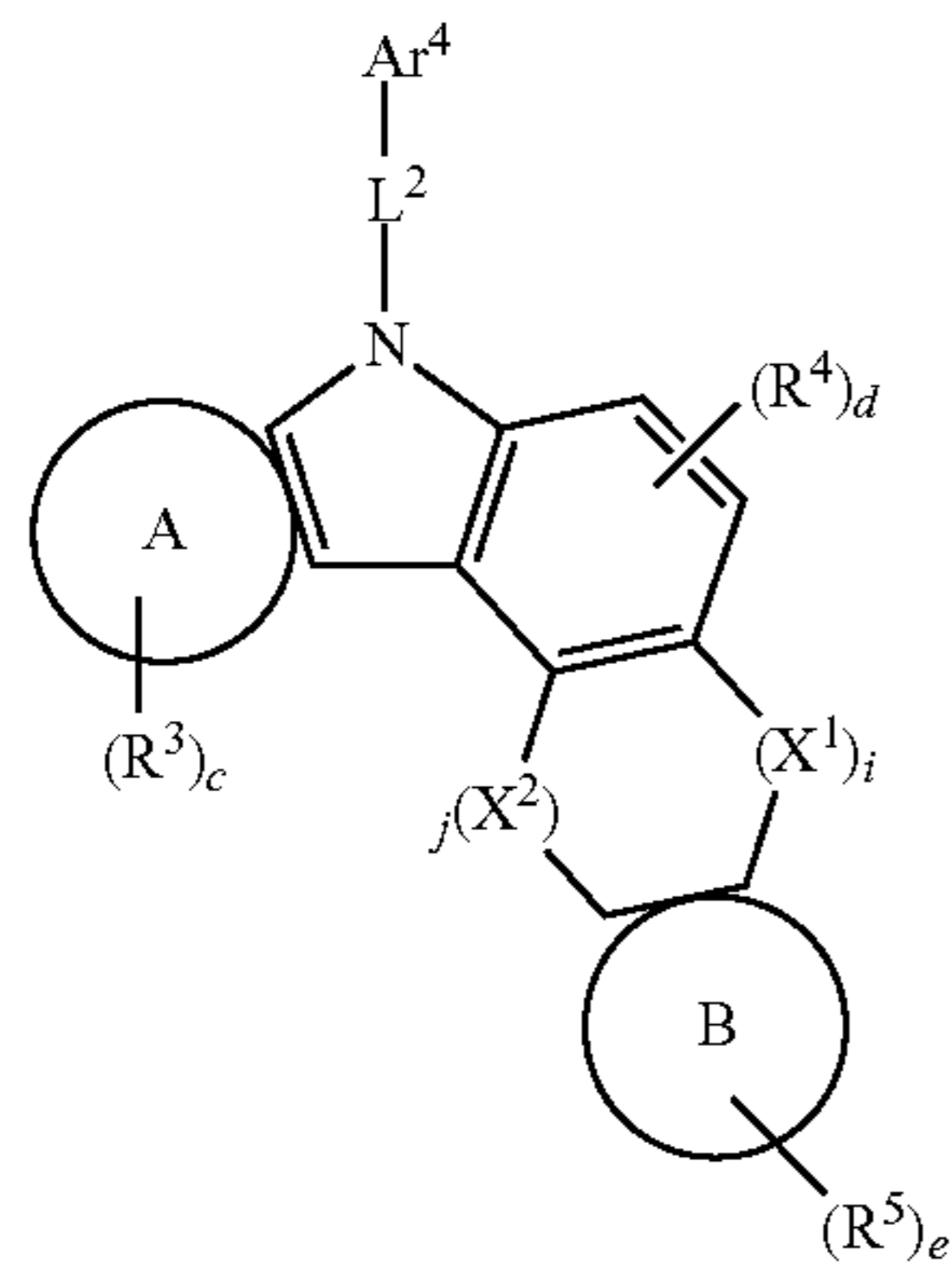
Hereinafter, a compound according to an aspect of the present invention and an organic electric element comprising the same will be described.

The present invention provides an organic electric element comprising a first electrode, a second electrode, and an organic material layer formed between the first electrode and the second electrode, wherein the organic material layer comprises an emitting layer, wherein the emitting layer comprises a first host compound represented by Formula (1) and a second host compound represented by Formula (2).

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Formula (1)



Formula (2)

{In Formulas (1) and (2),

1) Ar<sup>1</sup>, Ar<sup>2</sup>, Ar<sup>3</sup> and Ar<sup>4</sup> are each independently selected from the group consisting of a C<sub>6</sub>-C<sub>60</sub> aryl group; a fluorenyl group; a C<sub>2</sub>-C<sub>60</sub> heterocyclic group including at least one hetero atom of O, N, S, Si and P; a fused ring group of a C<sub>3</sub>-C<sub>60</sub> aliphatic ring and a C<sub>6</sub>-C<sub>60</sub> aromatic ring; a C<sub>1</sub>-C<sub>50</sub> alkyl group; a C<sub>2</sub>-C<sub>20</sub> alkenyl group; a C<sub>2</sub>-C<sub>20</sub> alkynyl group; a C<sub>1</sub>-C<sub>30</sub> alkoxy group; a C<sub>6</sub>-C<sub>30</sub> aryloxy group;

2) c and e are integer of 0 to 10, and d is an integer of 0 to 2, and R<sup>3</sup>, R<sup>4</sup> and R<sup>5</sup> are the same or different from each other, and are each independently selected from the group consisting of deuterium; halogen; a C<sub>6</sub>-C<sub>60</sub> aryl group; a fluorenyl group; a C<sub>2</sub>-C<sub>60</sub> heterocyclic group including at least one heteroatom of O, N, S, Si and P; a fused ring group of a C<sub>3</sub>-C<sub>60</sub> aliphatic ring and a C<sub>6</sub>-C<sub>60</sub> aromatic ring; a C<sub>1</sub>-C<sub>50</sub> alkyl group; a C<sub>2</sub>-C<sub>20</sub> alkenyl group; a C<sub>2</sub>-C<sub>20</sub> alkynyl group; a C<sub>1</sub>-C<sub>30</sub> alkoxy group; a C<sub>6</sub>-C<sub>30</sub> aryloxy group; and —L—N(R<sub>a</sub>)(R<sub>b</sub>); (wherein, L' is selected from the group consisting of a single bond; a C<sub>6</sub>-C<sub>60</sub> arylene group; a fluorenylene group; a fused ring group of a C<sub>3</sub>-C<sub>60</sub> aliphatic ring and a C<sub>6</sub>-C<sub>60</sub> aromatic ring; and a C<sub>2</sub>-C<sub>60</sub> heterocyclic; and R<sub>a</sub> and R<sub>b</sub> are independently selected from the group consisting of a C<sub>6</sub>-C<sub>60</sub> aryl group; a fluorenyl group; a fused ring group of a C<sub>3</sub>-C<sub>60</sub> aliphatic ring and a C<sub>6</sub>-C<sub>60</sub> aromatic ring; and a C<sub>2</sub>-C<sub>60</sub> heterocyclic group containing at least one hetero atom of O, N, S, Si, or P), or in case c, d and e are 2 or more, and R<sup>3</sup>, R<sup>4</sup> and R<sup>5</sup> are each in plural being the same or different, and a plurality of R<sup>3</sup> or a plurality of R<sup>4</sup> or a plurality of R<sup>5</sup> combine to each other to form a ring;

3) L<sup>1</sup>, L<sup>2</sup>, L<sup>3</sup> are L<sup>4</sup> each independently selected from the group consisting of a single bond; a C<sub>6</sub>-C<sub>60</sub> arylene group; and a fluorenylene group; a fused ring group of a C<sub>3</sub>-C<sub>60</sub> aliphatic ring and a C<sub>6</sub>-C<sub>60</sub> aromatic ring; and a C<sub>2</sub>-C<sub>60</sub> heterocyclic group;

4) A and B are each independently a C<sub>6</sub>-C<sub>60</sub> aryl group or a C<sub>2</sub>-C<sub>20</sub> heterocyclic group, wherein both A and B are a substituted or unsubstituted C<sub>6</sub> aryl group (phenyl group), d is 2, and R<sup>4</sup>s are bonded to each other to form a ring to form an aromatic or hetero ring,

10

5) i and j are independently 0 or 1,

with the proviso that i+j is 1 or more, and when i or j is 0, it means a direct bond,

6) X<sup>1</sup> and X<sup>2</sup> are independently NR', O, S, or CR'R'';

wherein R' and R'' are independently hydrogen; a C<sub>6</sub>-C<sub>60</sub> aryl group; a fluorenyl group; a C<sub>3</sub>-C<sub>60</sub> heterocyclic group; or a C<sub>1</sub>-C<sub>50</sub> alkyl group;

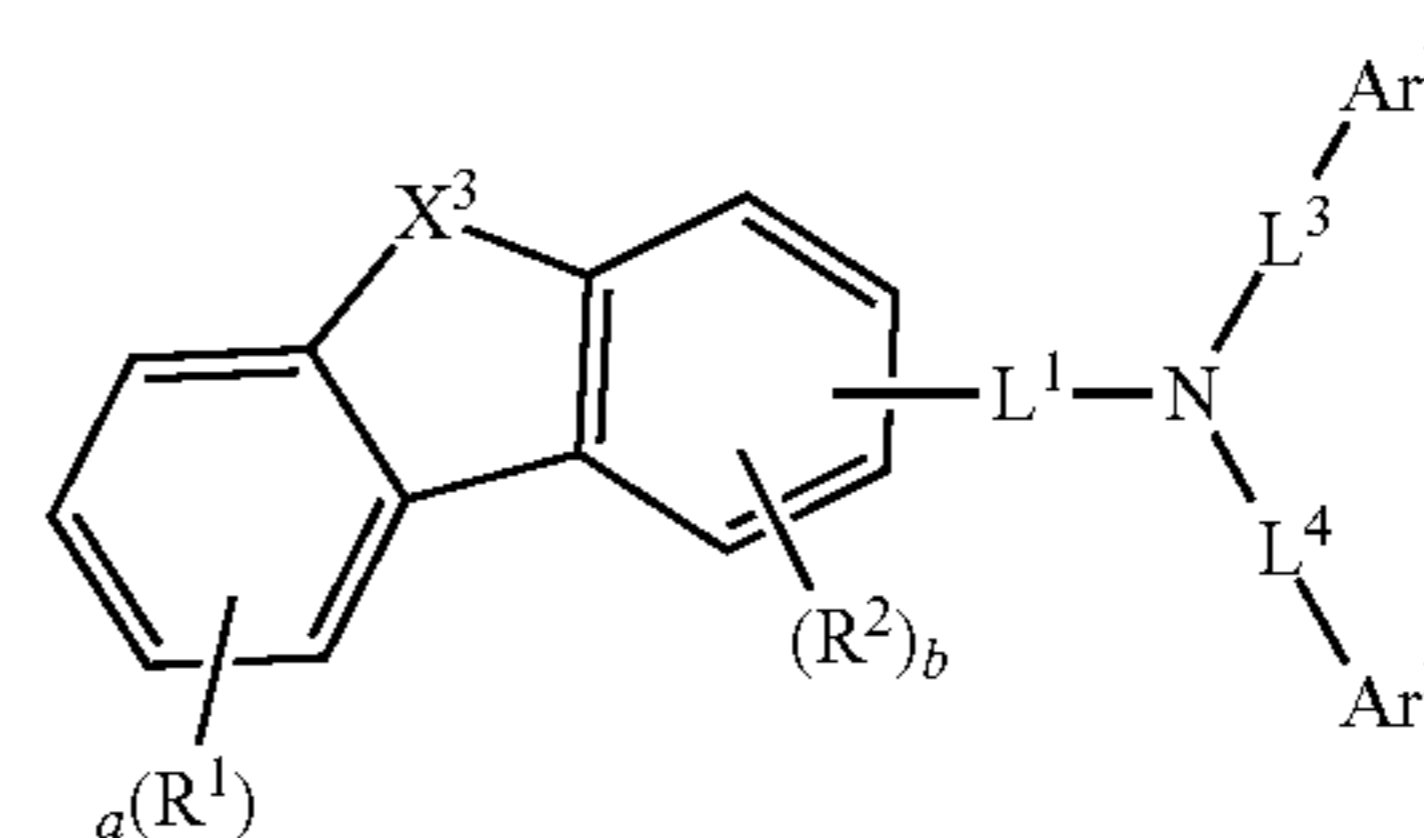
wherein R' and R'' may combine to each other to form a spiro,

(wherein, the aryl group, fluorenyl group, arylene group, heterocyclic group, fused ring group, alkyl group, alkenyl group, alkoxy group and aryloxy group may be substituted with one or more substituents selected from the group consisting of deuterium; halogen; a silane group substituted or unsubstituted with C<sub>1</sub>-C<sub>20</sub> alkyl group or C<sub>6</sub>-C<sub>20</sub> aryl group; siloxane group; boron group; germanium group; cyano group; nitro group; —L'—N(R<sub>a</sub>)(R<sub>b</sub>); a C<sub>1</sub>-C<sub>20</sub> alkylthio group; C<sub>1</sub>-C<sub>20</sub> alkoxy group; C<sub>1</sub>-C<sub>20</sub> alkyl group; C<sub>2</sub>-C<sub>20</sub> alkenyl group; C<sub>2</sub>-C<sub>20</sub> alkynyl group; C<sub>6</sub>-C<sub>20</sub> aryl group; C<sub>6</sub>-C<sub>20</sub> aryl group substituted with deuterium; a fluorenyl group; C<sub>2</sub>-C<sub>20</sub> heterocyclic group; C<sub>3</sub>-C<sub>20</sub> cycloalkyl group; C<sub>7</sub>-C<sub>20</sub> arylalkyl group; and C<sub>8</sub>-C<sub>20</sub> arylalkenyl group; wherein the substituents may combine each other and form a saturated or unsaturated ring, wherein the term 'ring' means C<sub>3</sub>-C<sub>60</sub> aliphatic ring or C<sub>6</sub>-C<sub>60</sub> aromatic ring or a C<sub>2</sub>-C<sub>60</sub> heterocyclic ring or a fused ring formed by the combination of thereof.)}

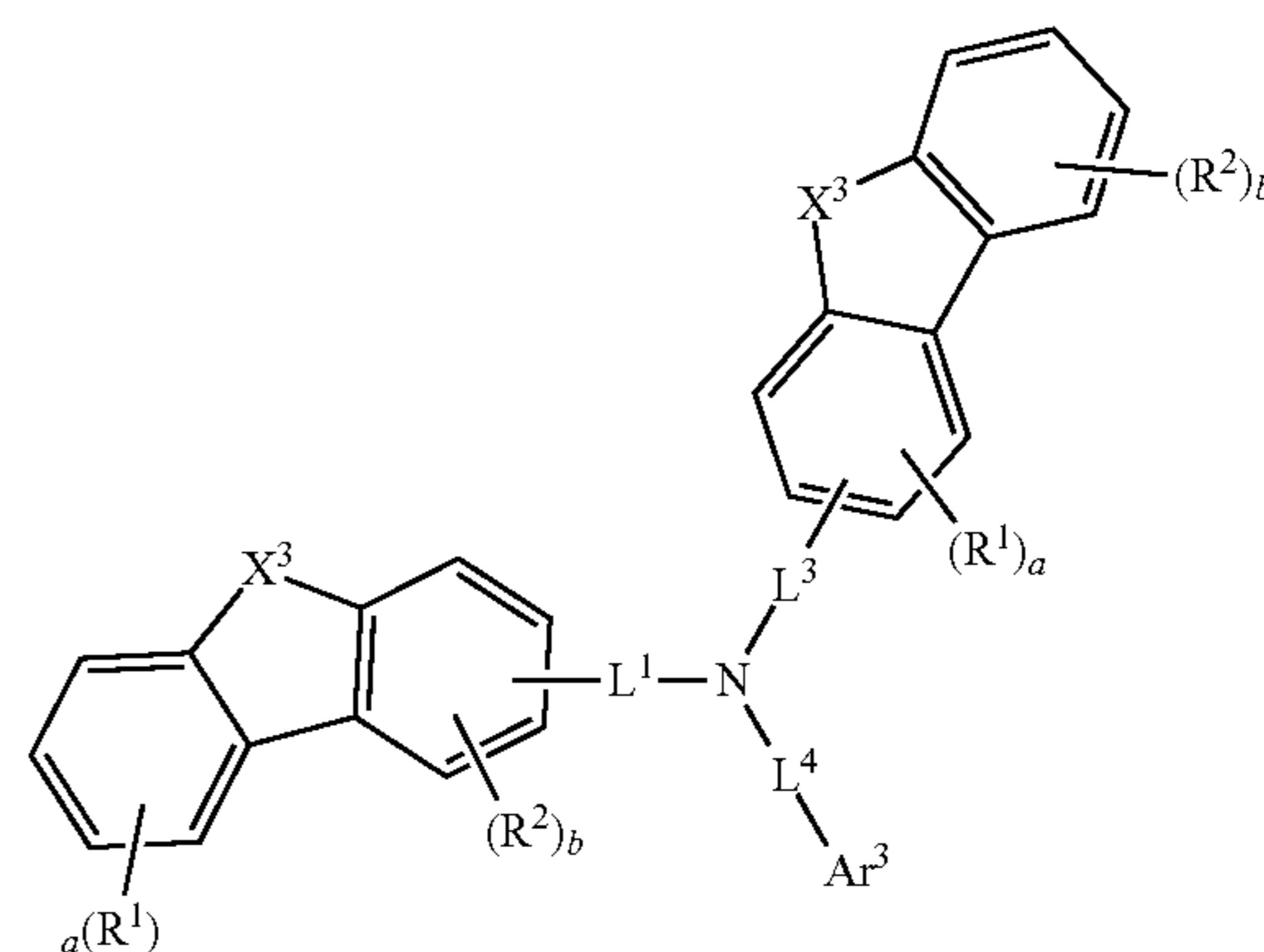
In addition, the present invention provides the compounds represented by Formulas (1) and (2).

The first host compound represented by Formula (1) is represented by any one of the following Formulas (3) to (5).

Formula (3)



Formula (4)

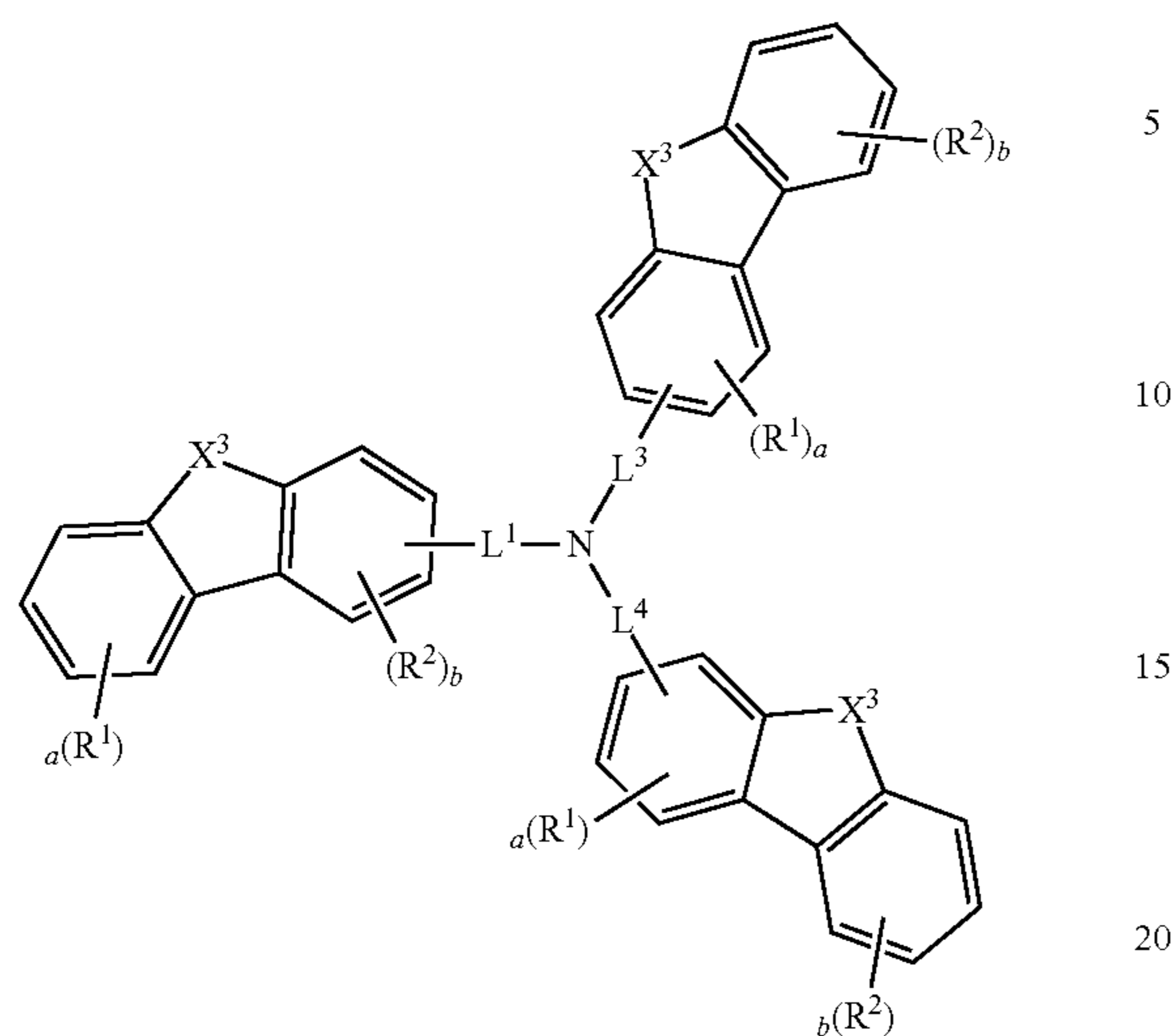




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Formula (5)



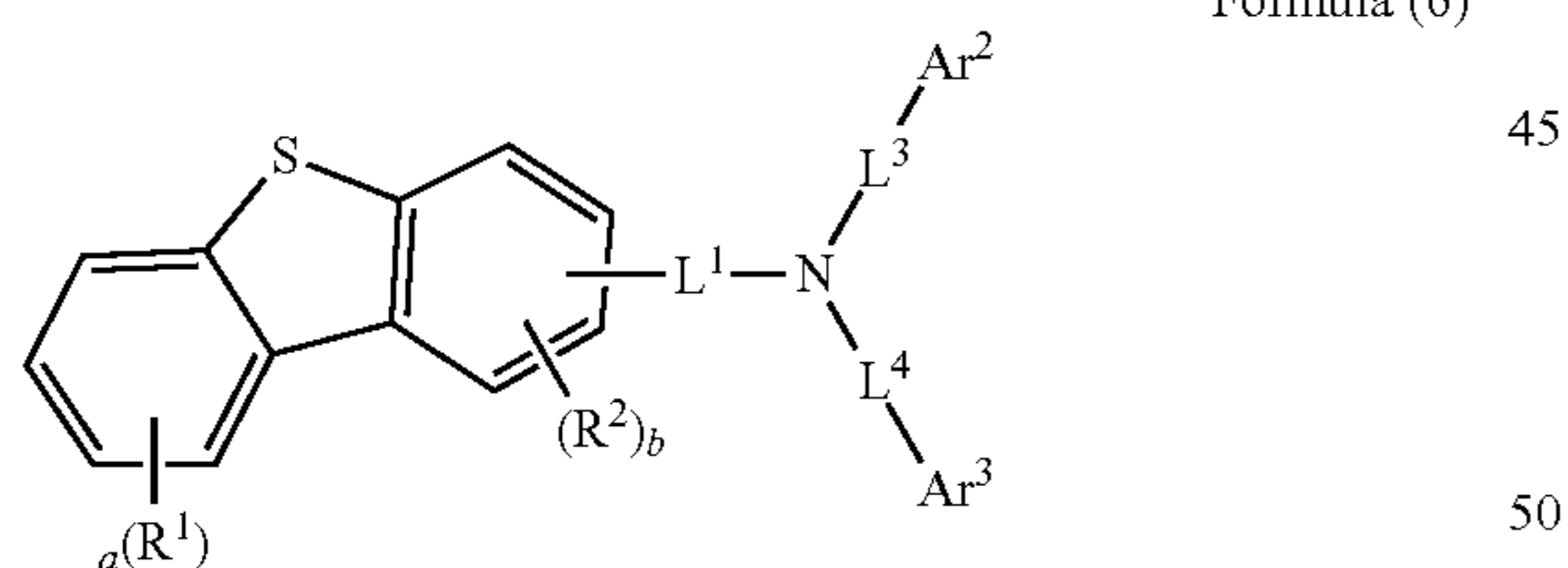
{In Formulas (3) to (5),  
1) L<sup>1</sup>, L<sup>3</sup>, L<sup>4</sup>, Ar<sup>2</sup> and Ar<sup>3</sup> are the same as defined in  
Formula (1),

2) X<sup>3</sup> is O or S,

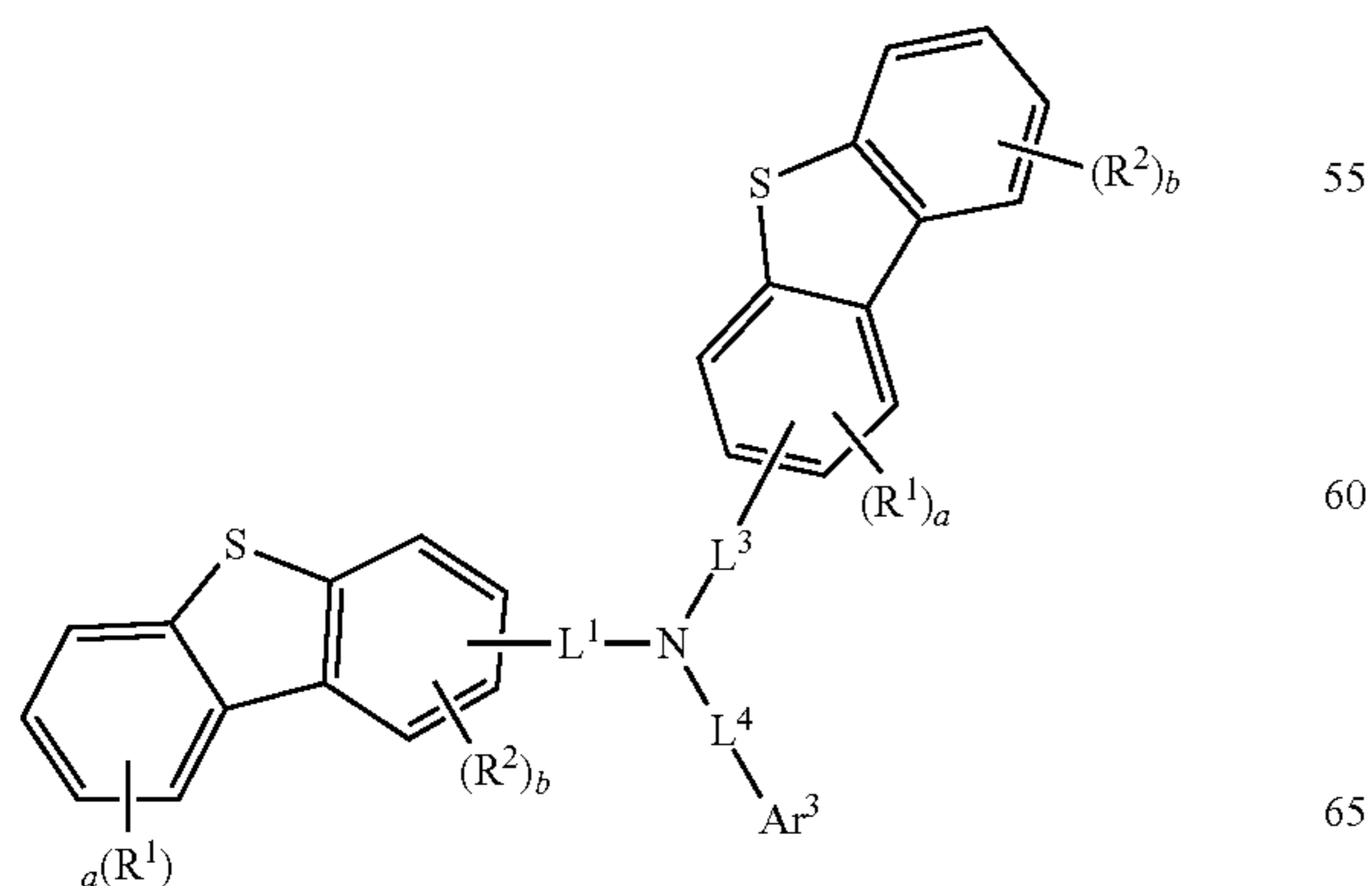
3) a is an of 0 to 4, and b is an integer of 0 to 3, and R<sup>1</sup>  
and R<sup>2</sup> are the same or different from each other, and are  
each independently selected from the group consisting of  
deuterium; halogen; a C<sub>6</sub>-C<sub>60</sub> aryl group; a fluorenyl group;  
a C<sub>2</sub>-C<sub>60</sub> heterocyclic group including at least one heteroa-  
tom of O, N, S, Si and P; a fused ring group of a C<sub>3</sub>-C<sub>60</sub>  
aliphatic ring and a C<sub>6</sub>-C<sub>60</sub> aromatic ring; a C<sub>1</sub>-C<sub>50</sub> alkyl  
group; a C<sub>2</sub>-C<sub>20</sub> alkenyl group; a C<sub>2</sub>-C<sub>20</sub> alkynyl group; a  
C<sub>1</sub>-C<sub>30</sub> alkoxy group; a C<sub>6</sub>-C<sub>30</sub> aryloxy group; and —L'-N  
(R<sub>a</sub>)(R<sub>b</sub>); or in case a and b are 2 or more, R<sup>1</sup> and R<sup>2</sup> are each  
in plural being the same or different, and a plurality of R<sup>1</sup> or  
a plurality of R<sup>2</sup> combine to each other to form a ring.}

The first host compound represented by Formula (1) is  
represented by any one of the following Formulas (6) to  
(14).

Formula (6)



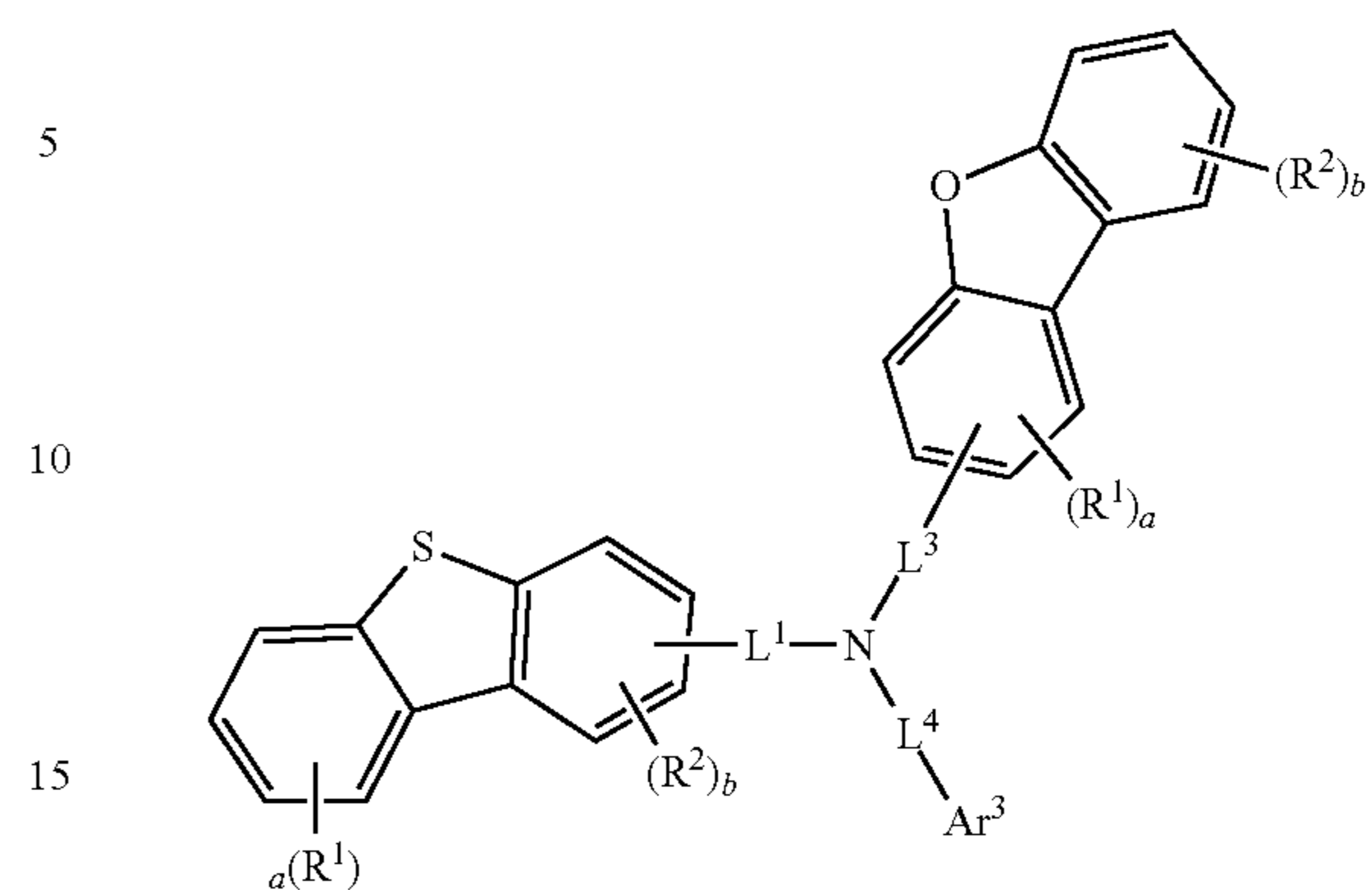
Formula (7)



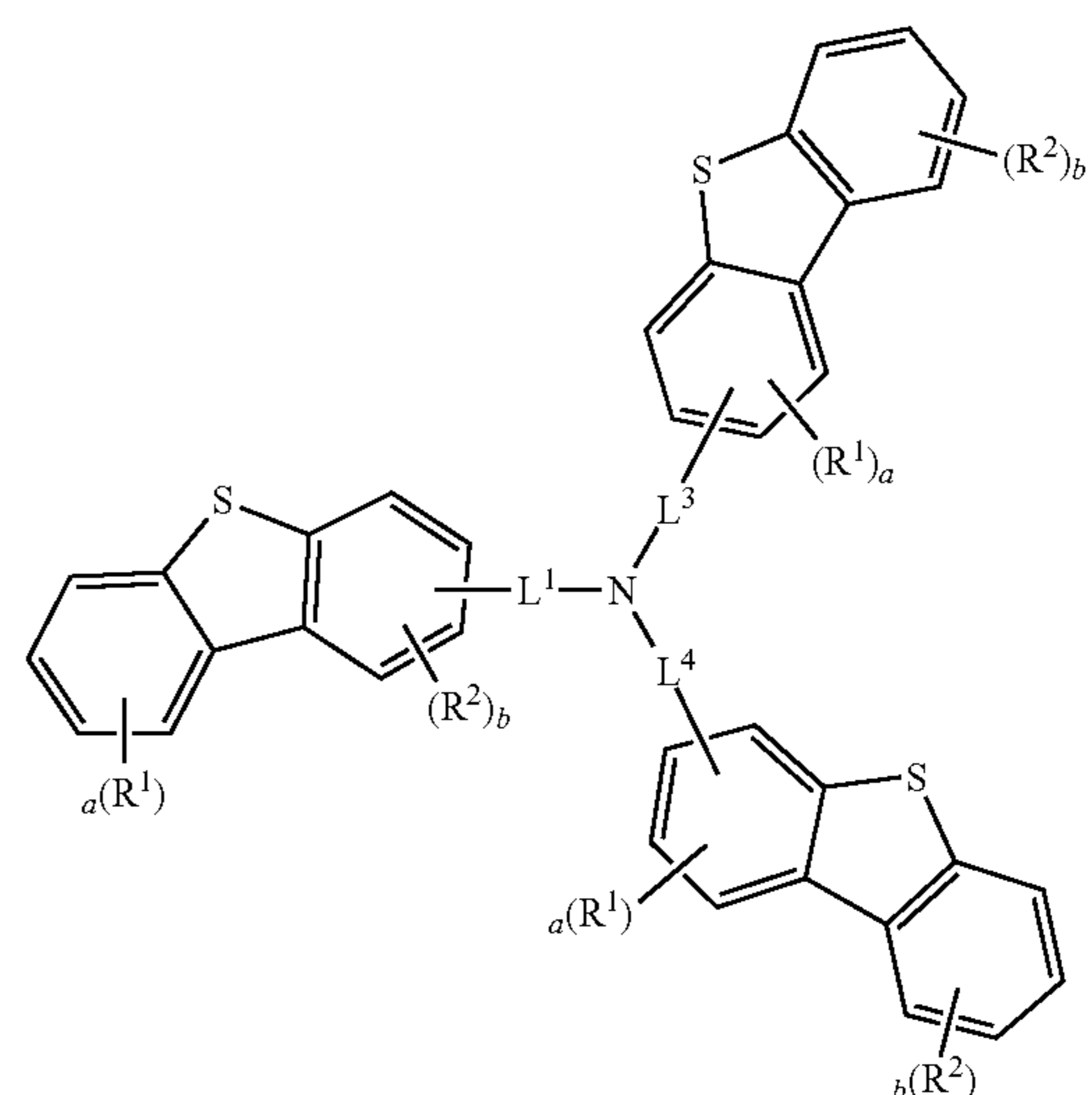
12

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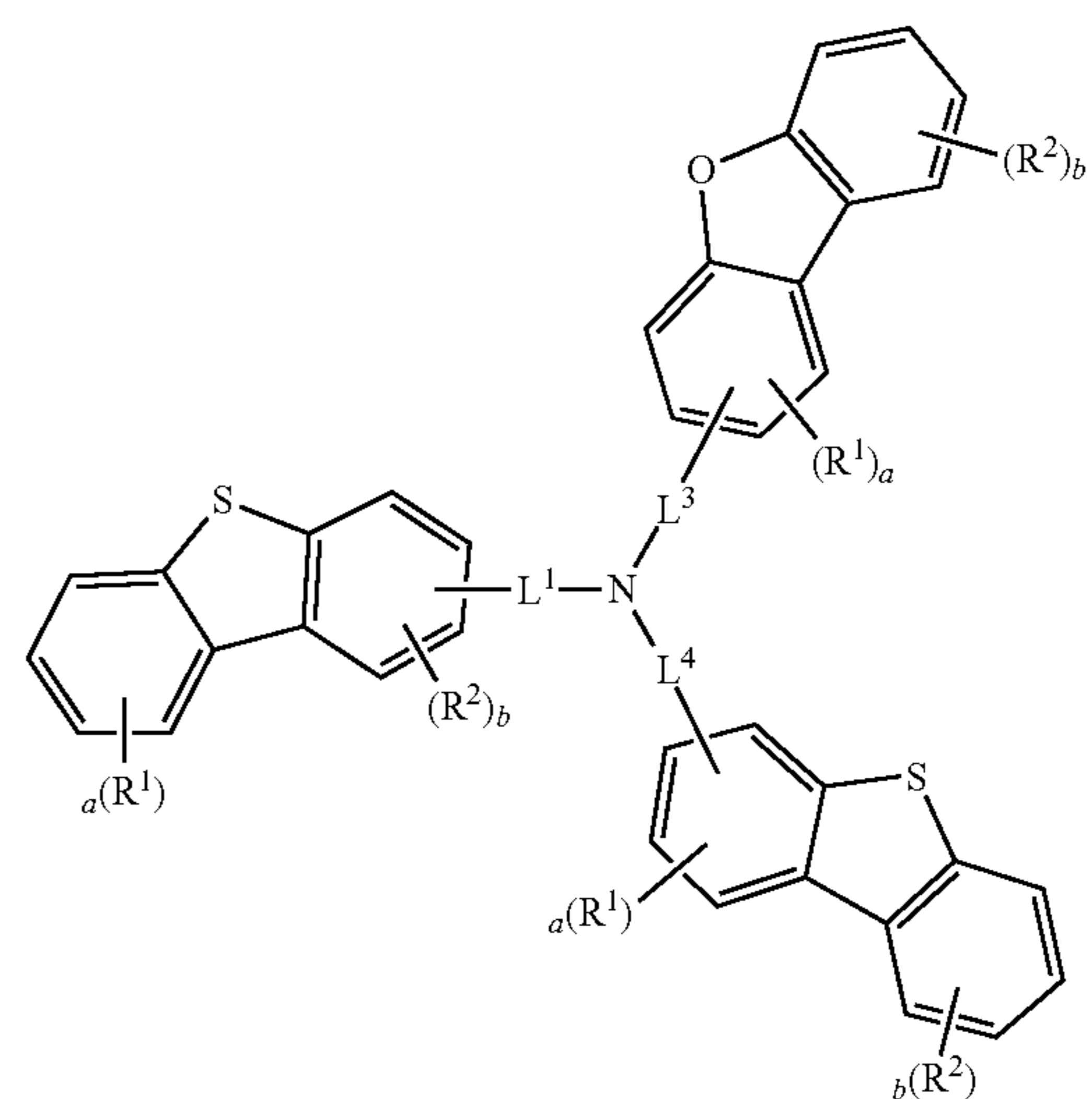
Formula (8)



Formula (9)



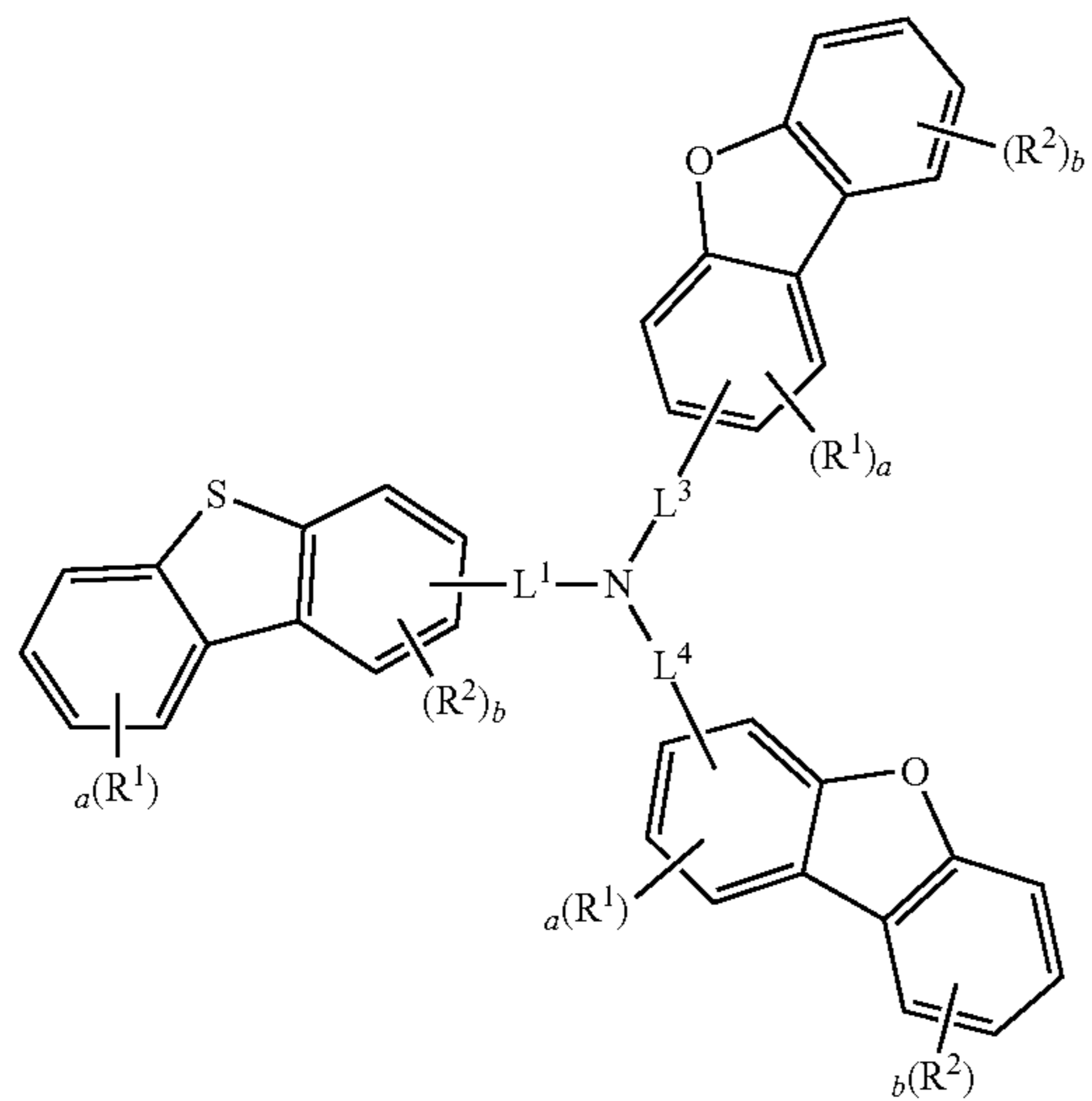
Formula (10)



13

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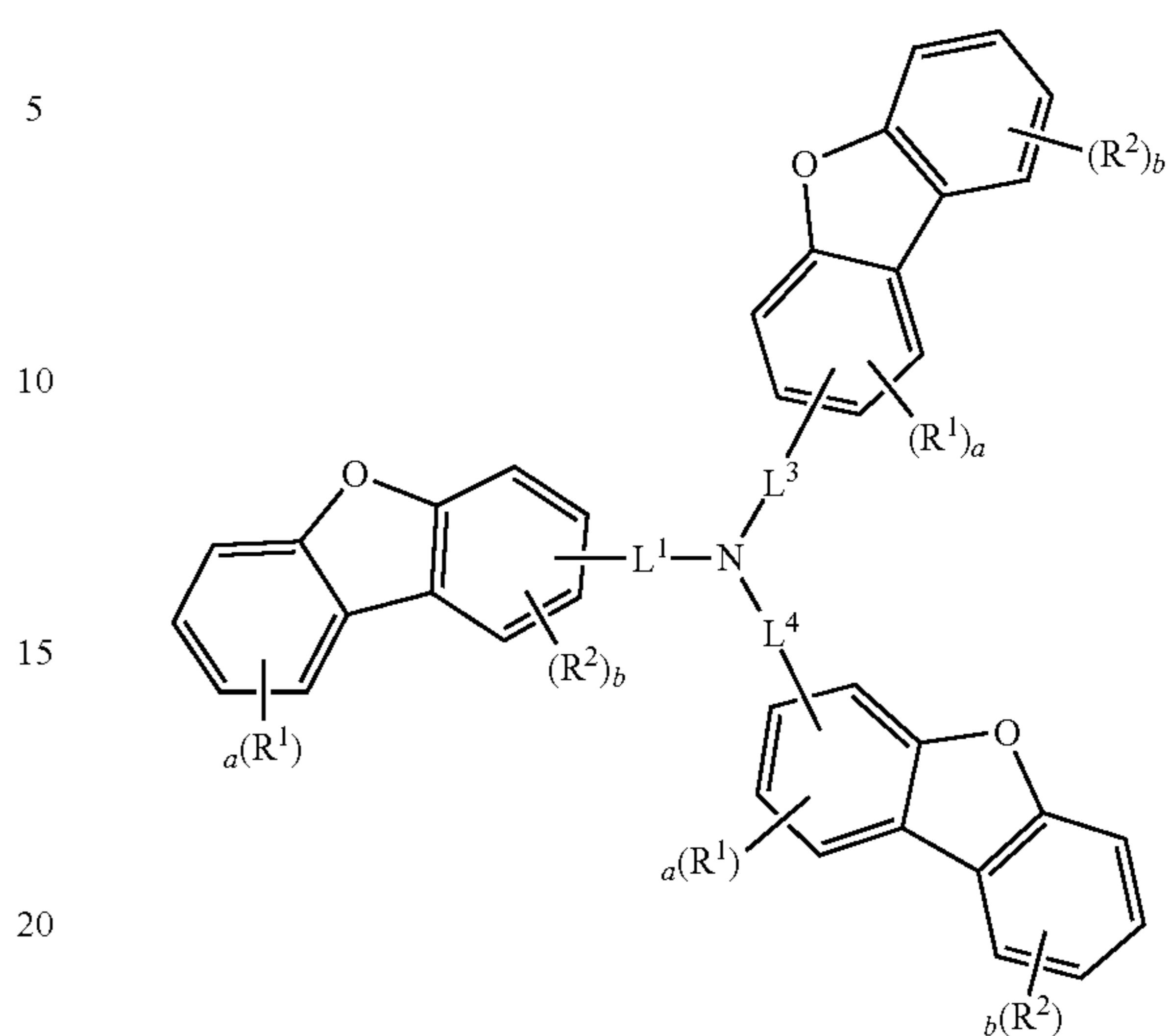
Formula (11)



14

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Formula (14)

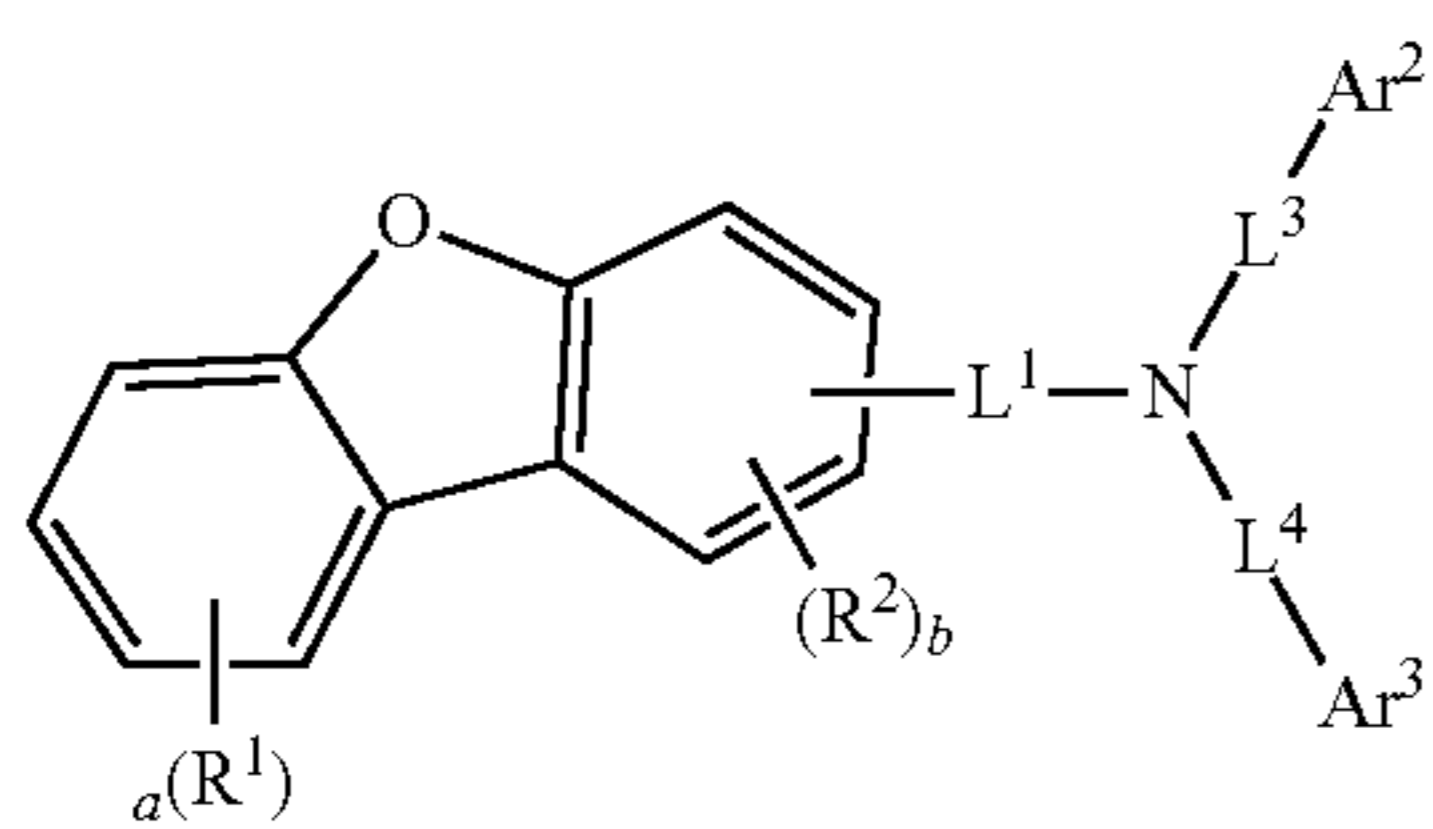


{In Formulas (6) to (14),  
 $L^1, L^3, L^4, Ar^2$  and  $Ar^3$  are the same as defined in Formula (1) and

$R^1, R^2, a$  and  $b$  are the same as defined in Formulas (3) to (5).}

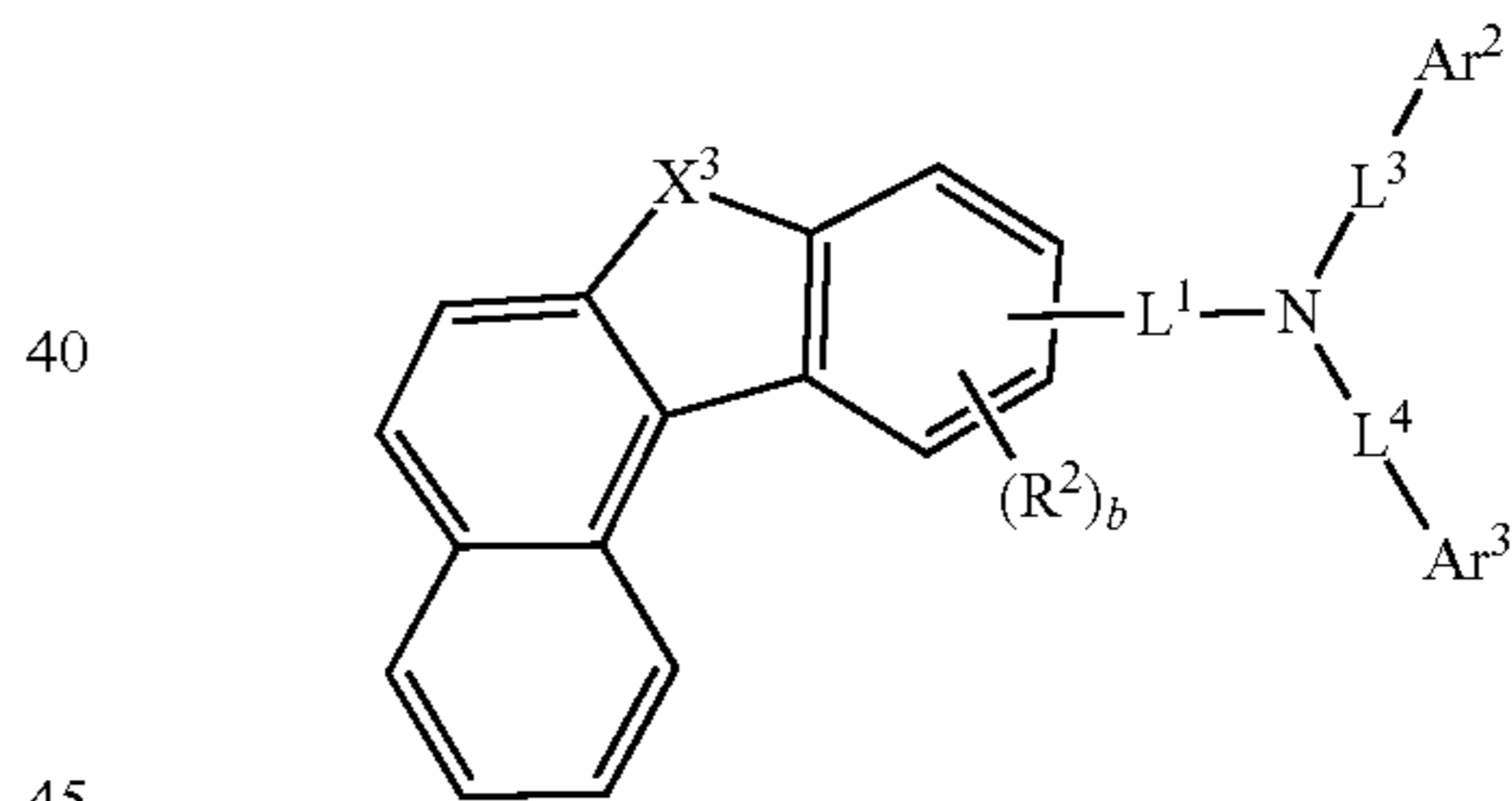
The first host compound represented by Formula (1) is represented by any one of the following Formulas (15) to (23).

Formula (12)



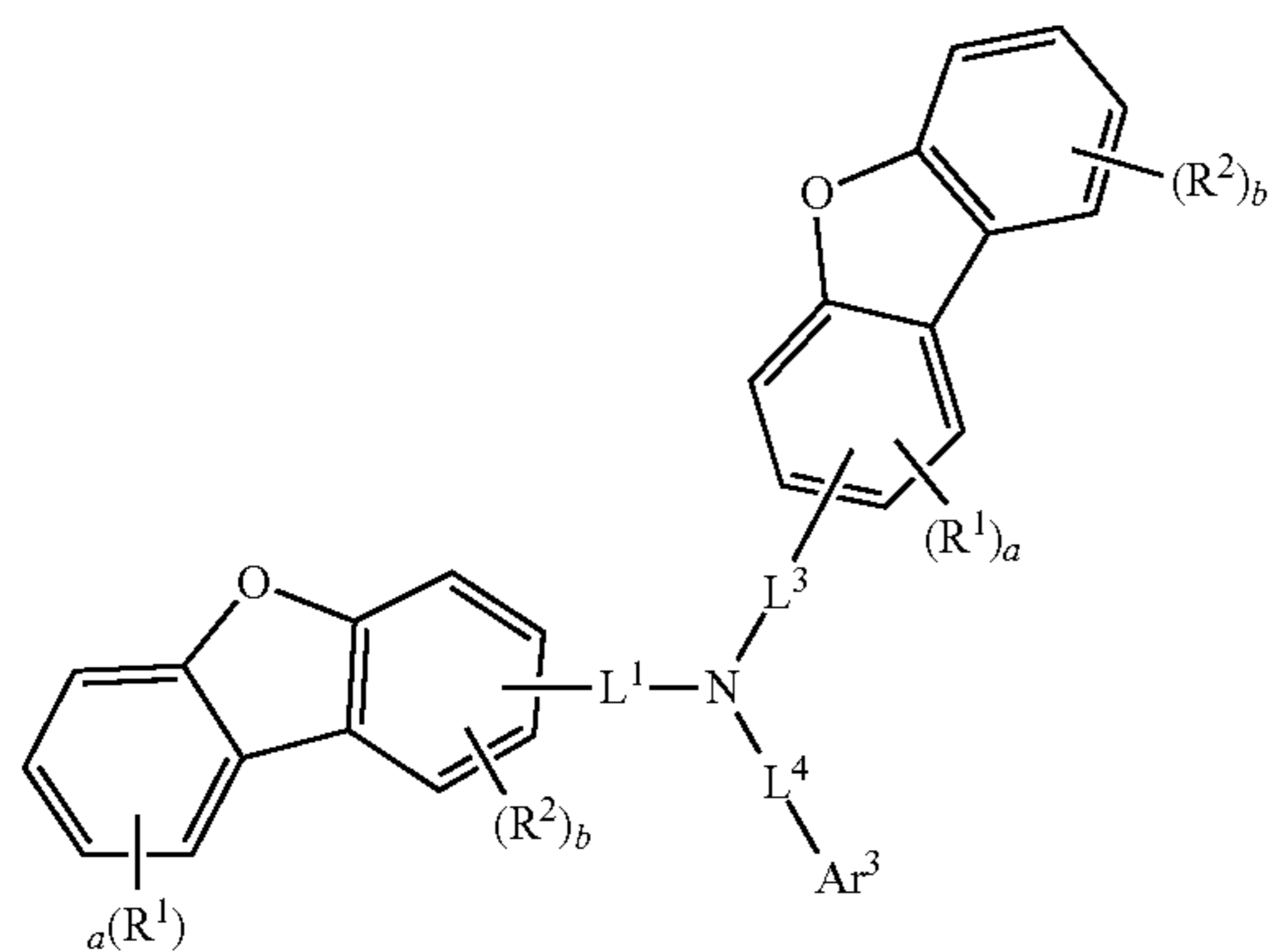
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Formula (15)



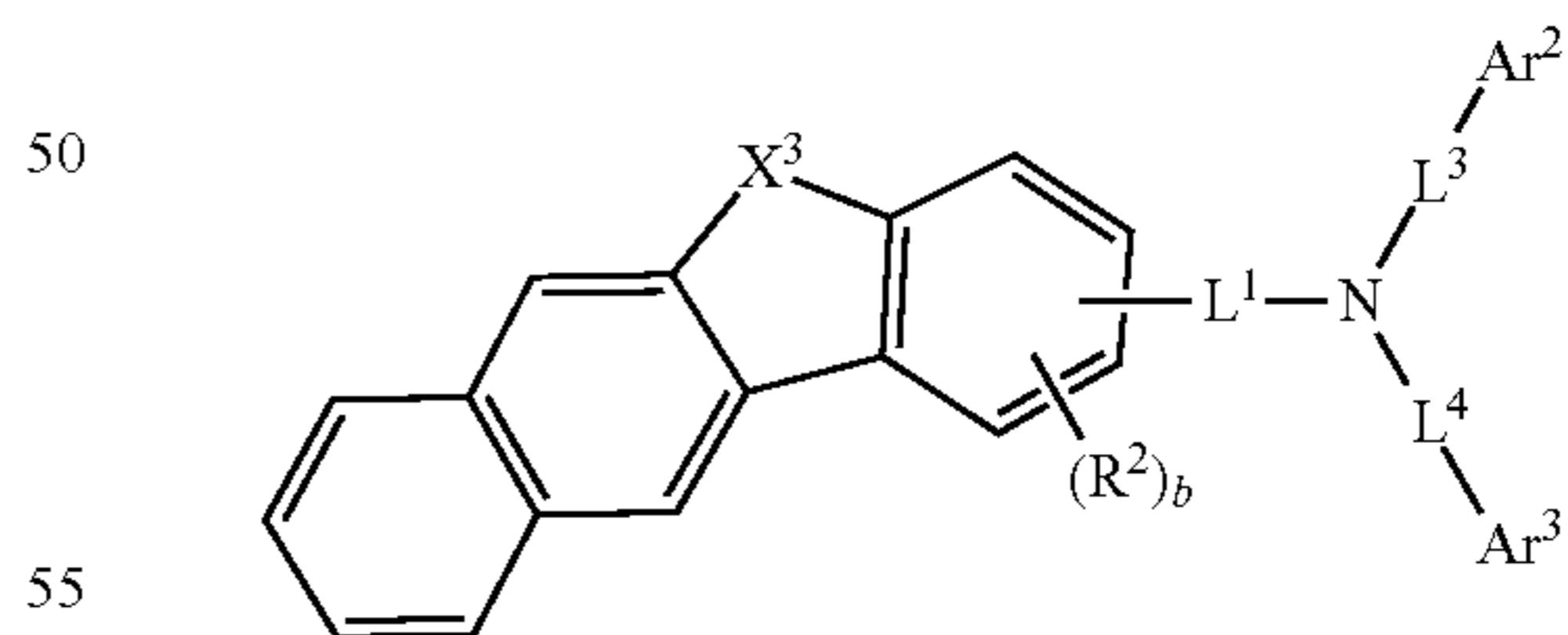
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Formula (13)



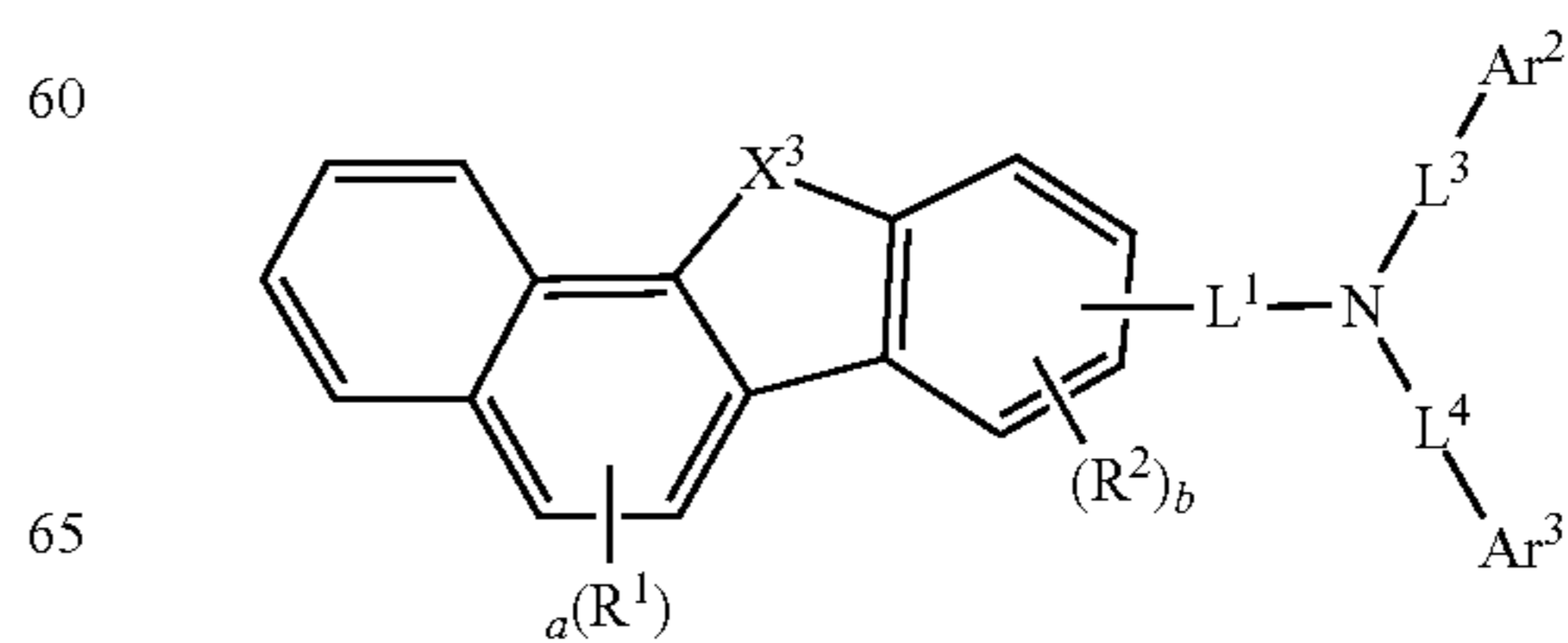
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Formula (16)



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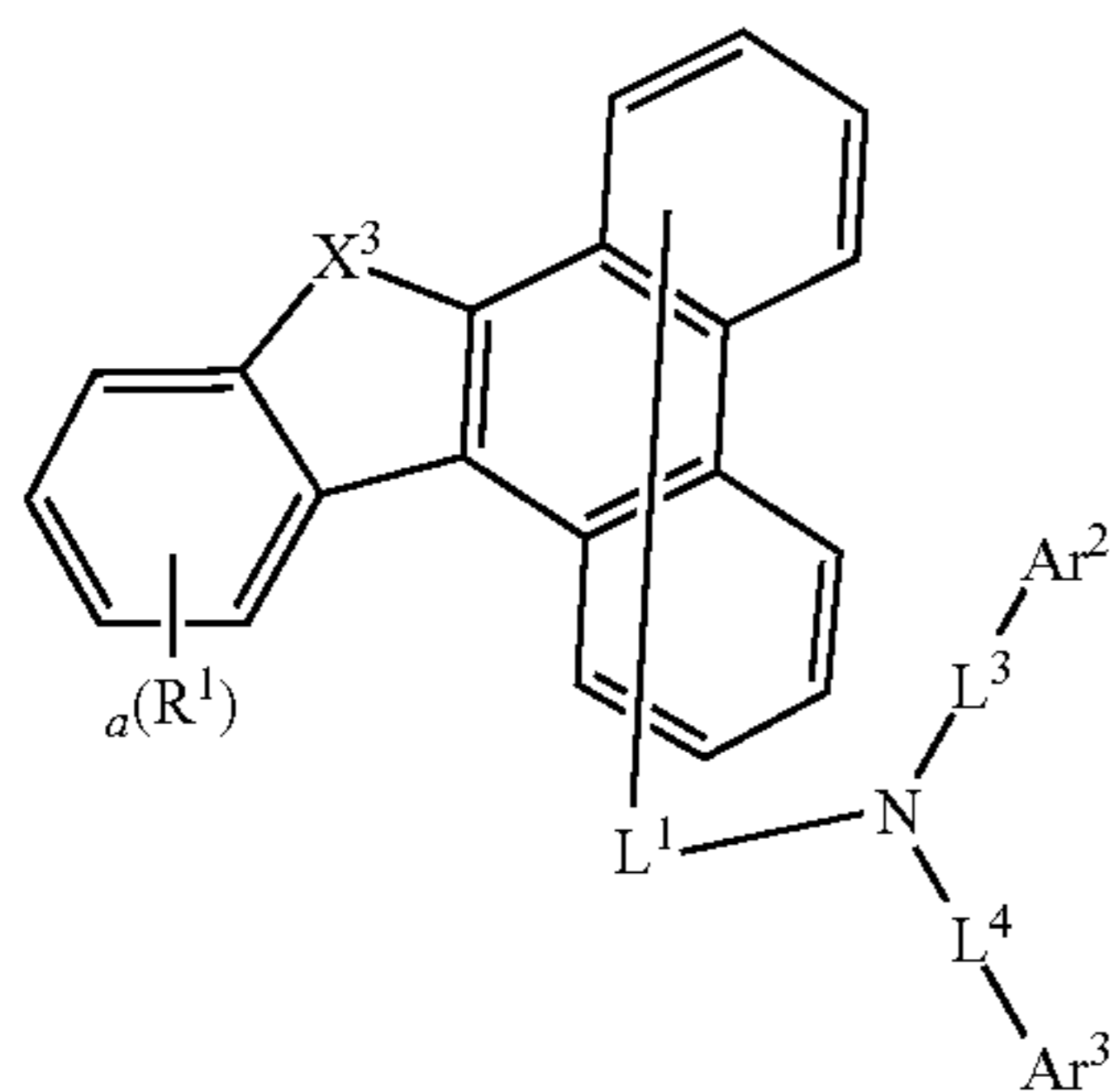
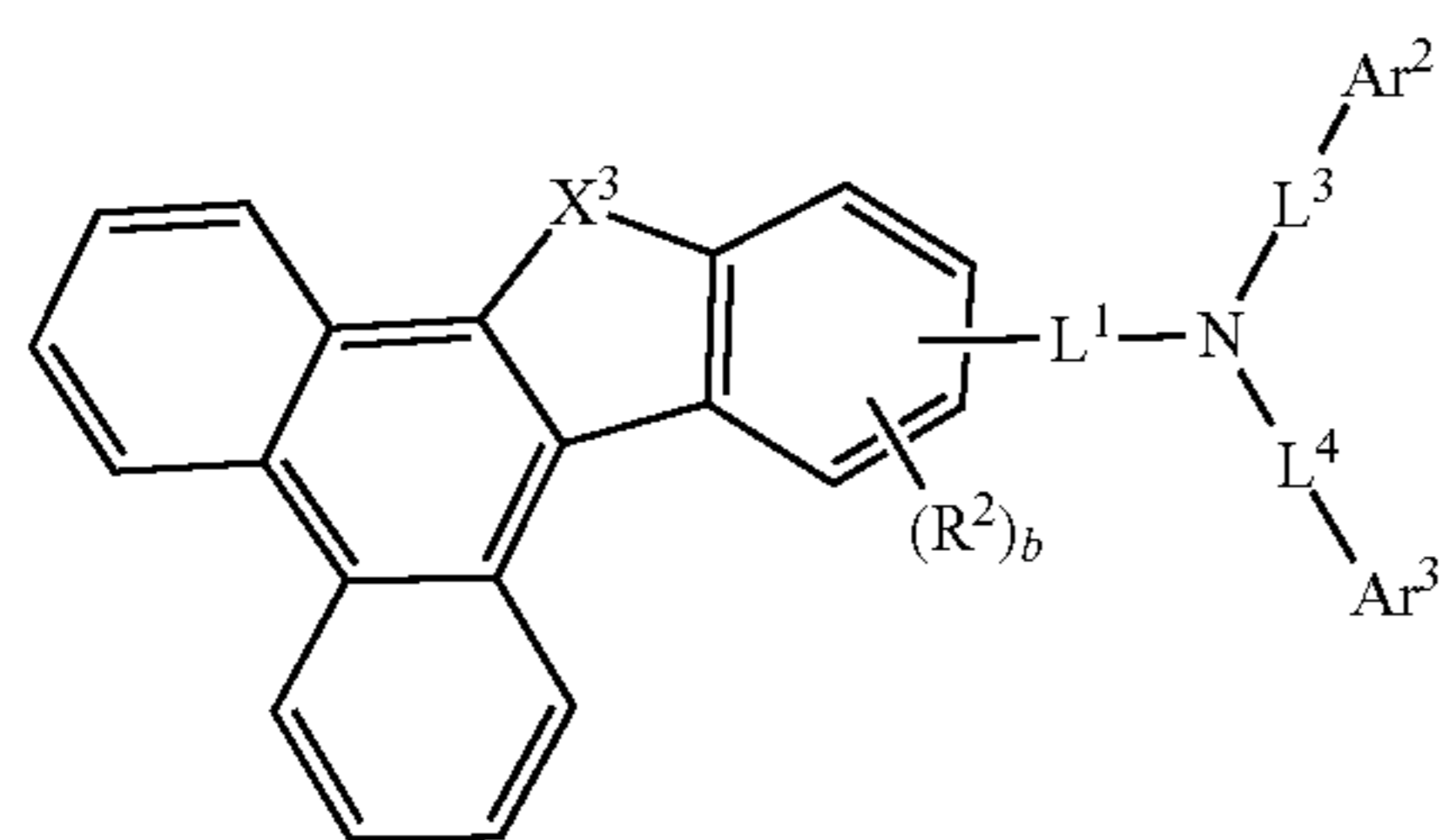
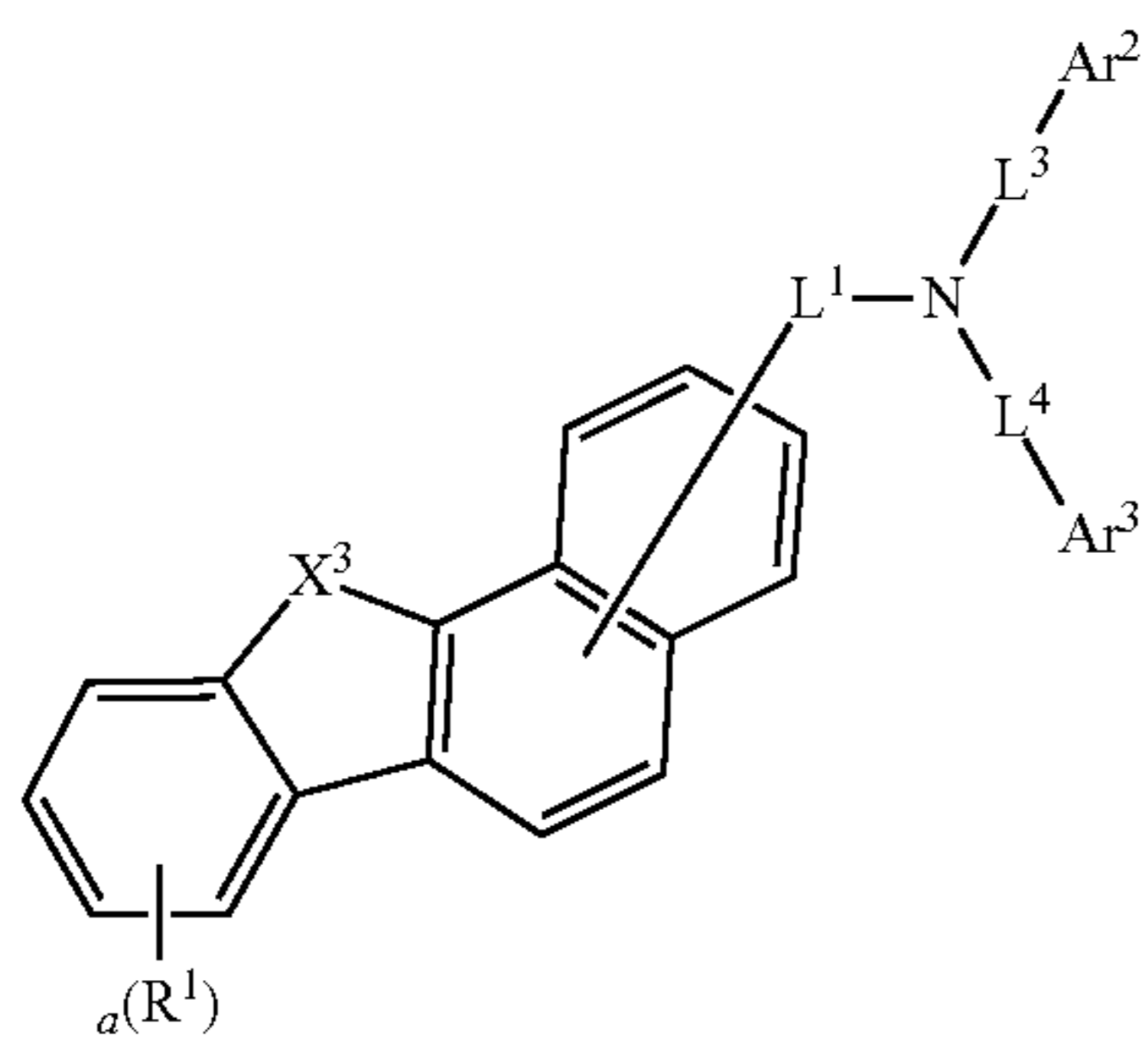
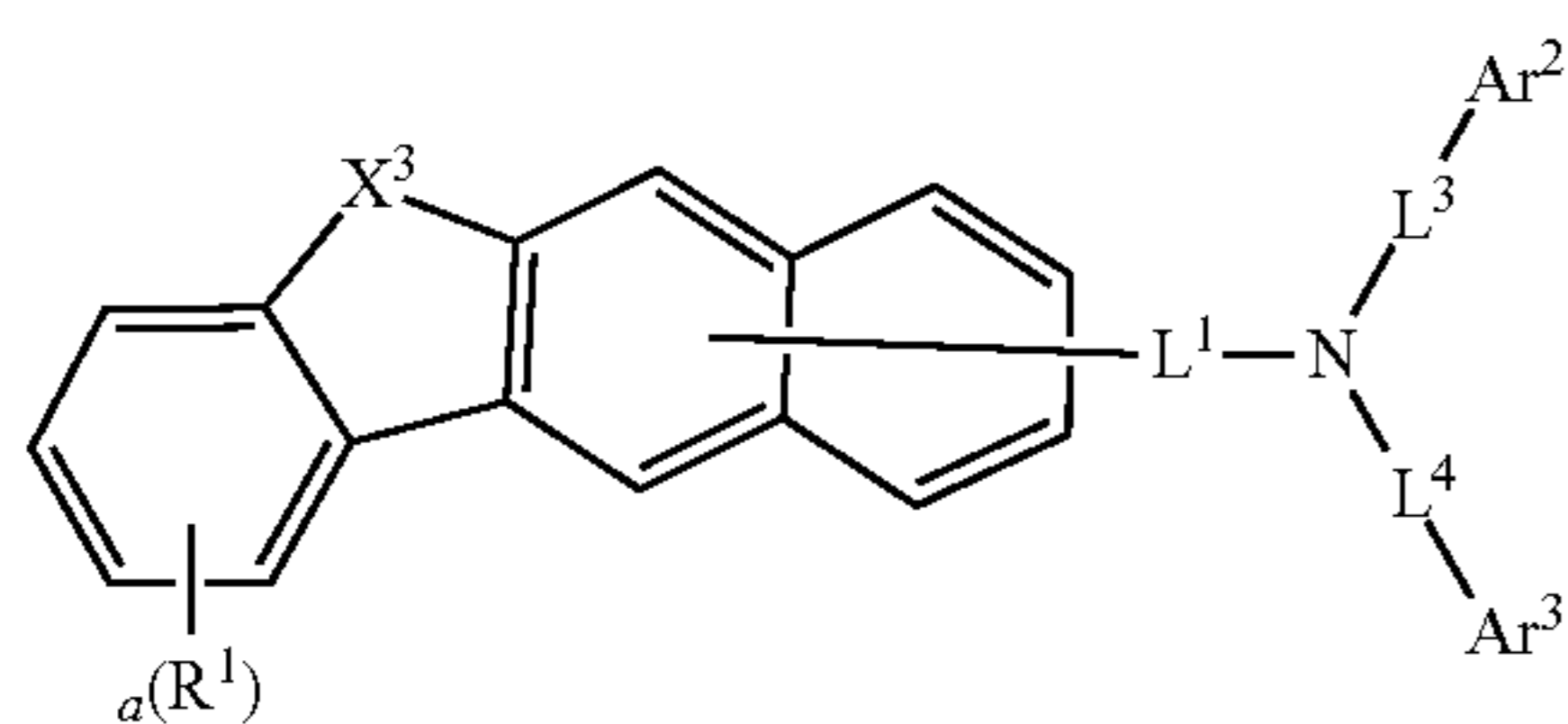
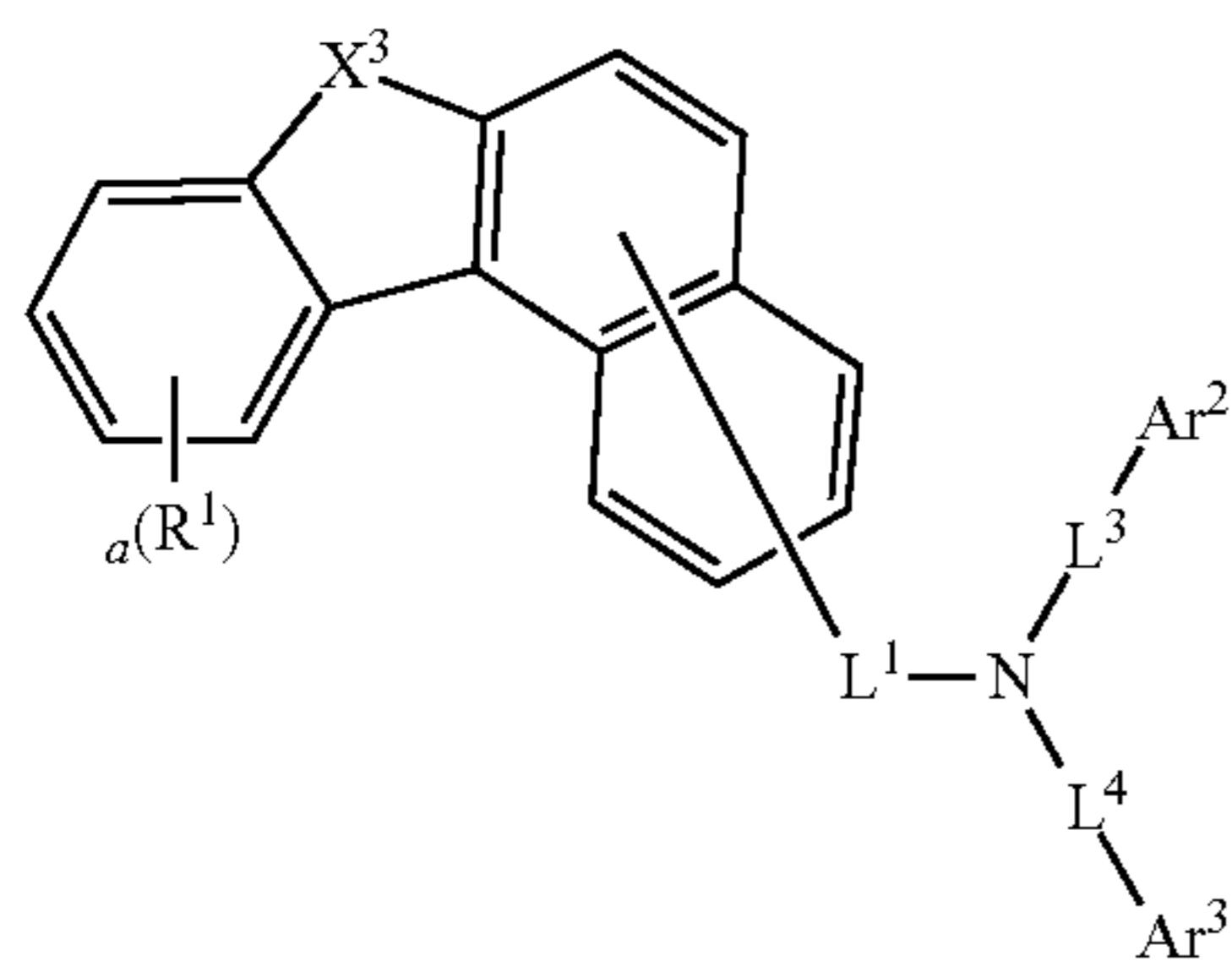
Formula (17)



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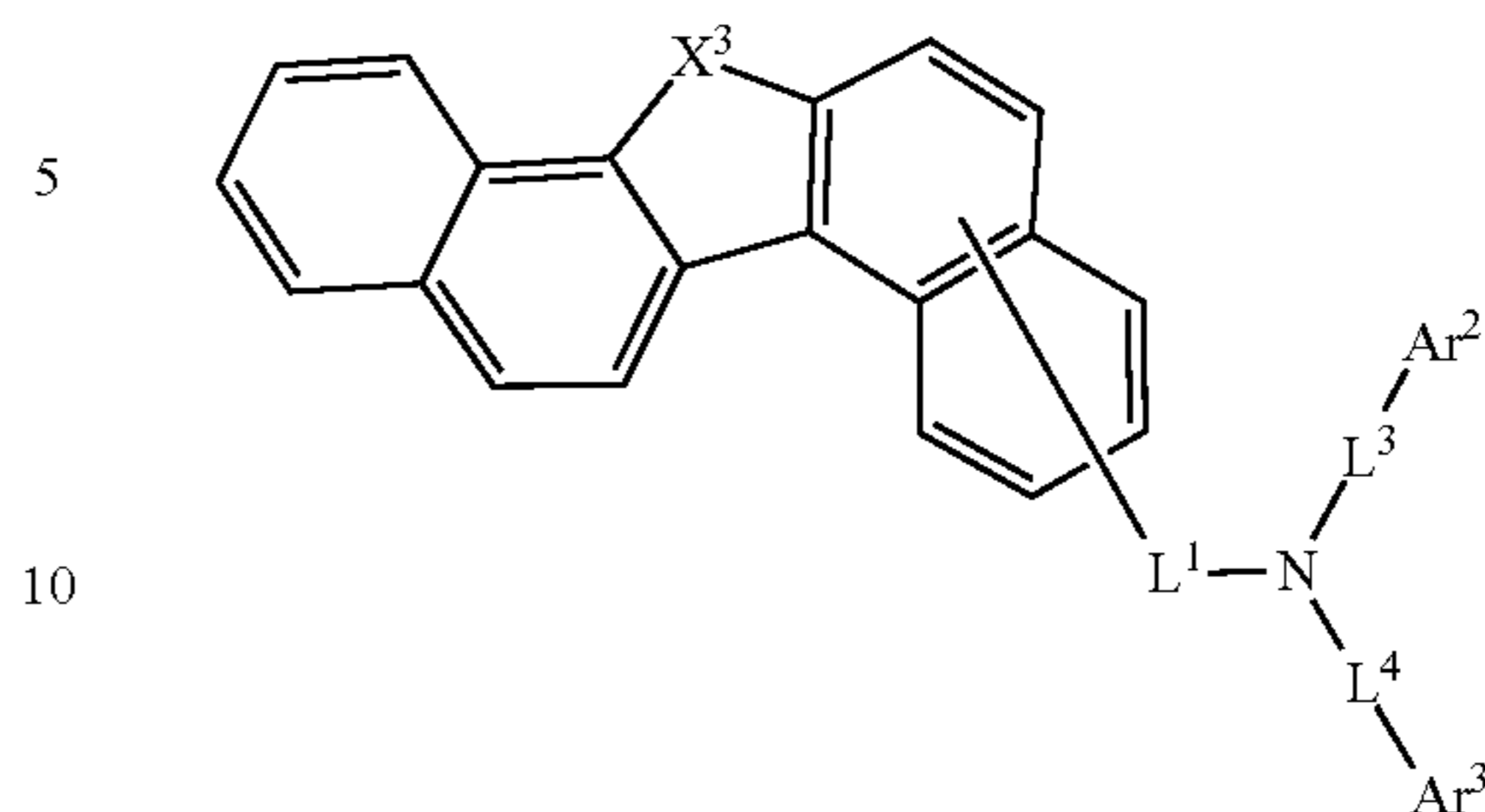
**15**

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**16**

-continued

Formula (18)



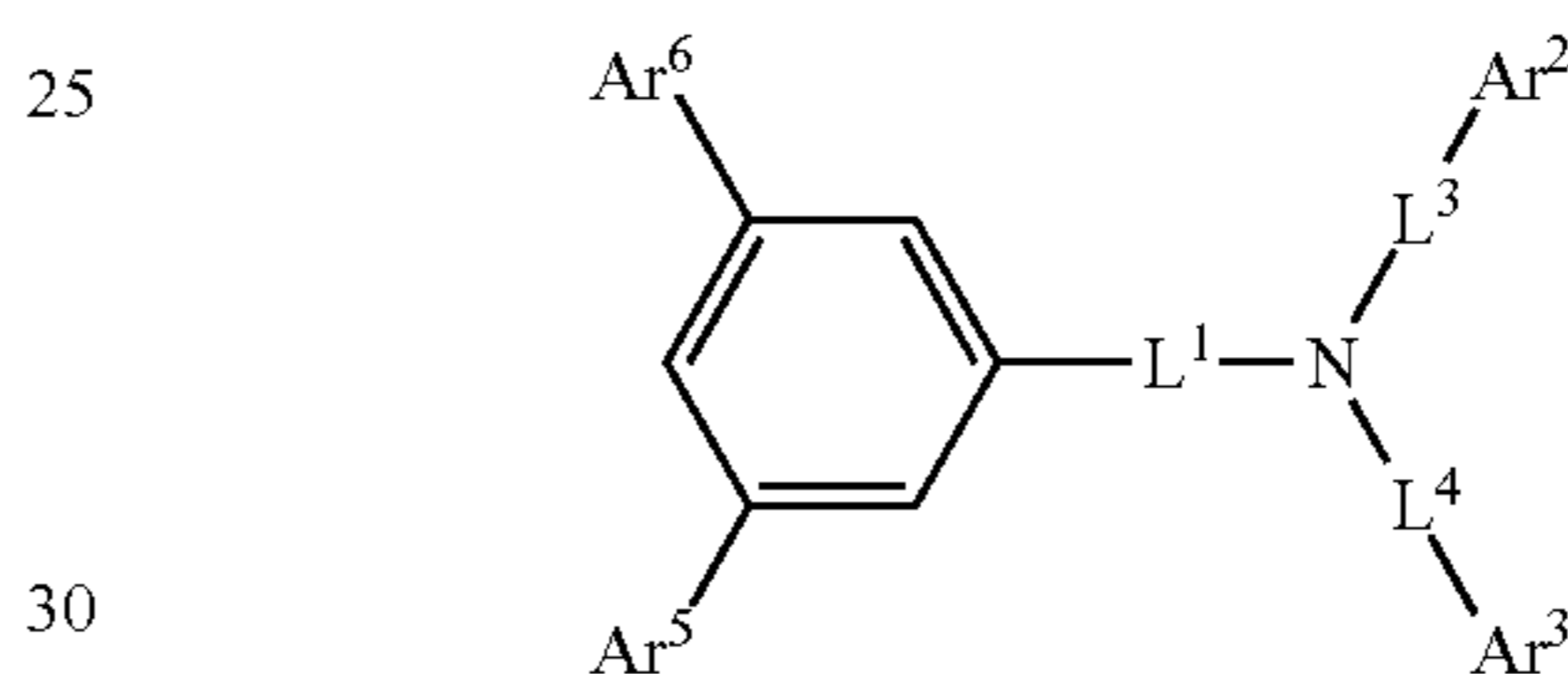
Formula (23)

Formula (19)

15 {In Formulas (15) to (23),  
 $L^1$ ,  $L^3$ ,  $L^4$ ,  $Ar^2$  and  $Ar^3$  are the same as defined in Formula (1), and  $X^3$ ,  $R^1$ ,  $R^2$ ,  $a$  and  $b$  are the same as defined in Formulas (3) to (5).}

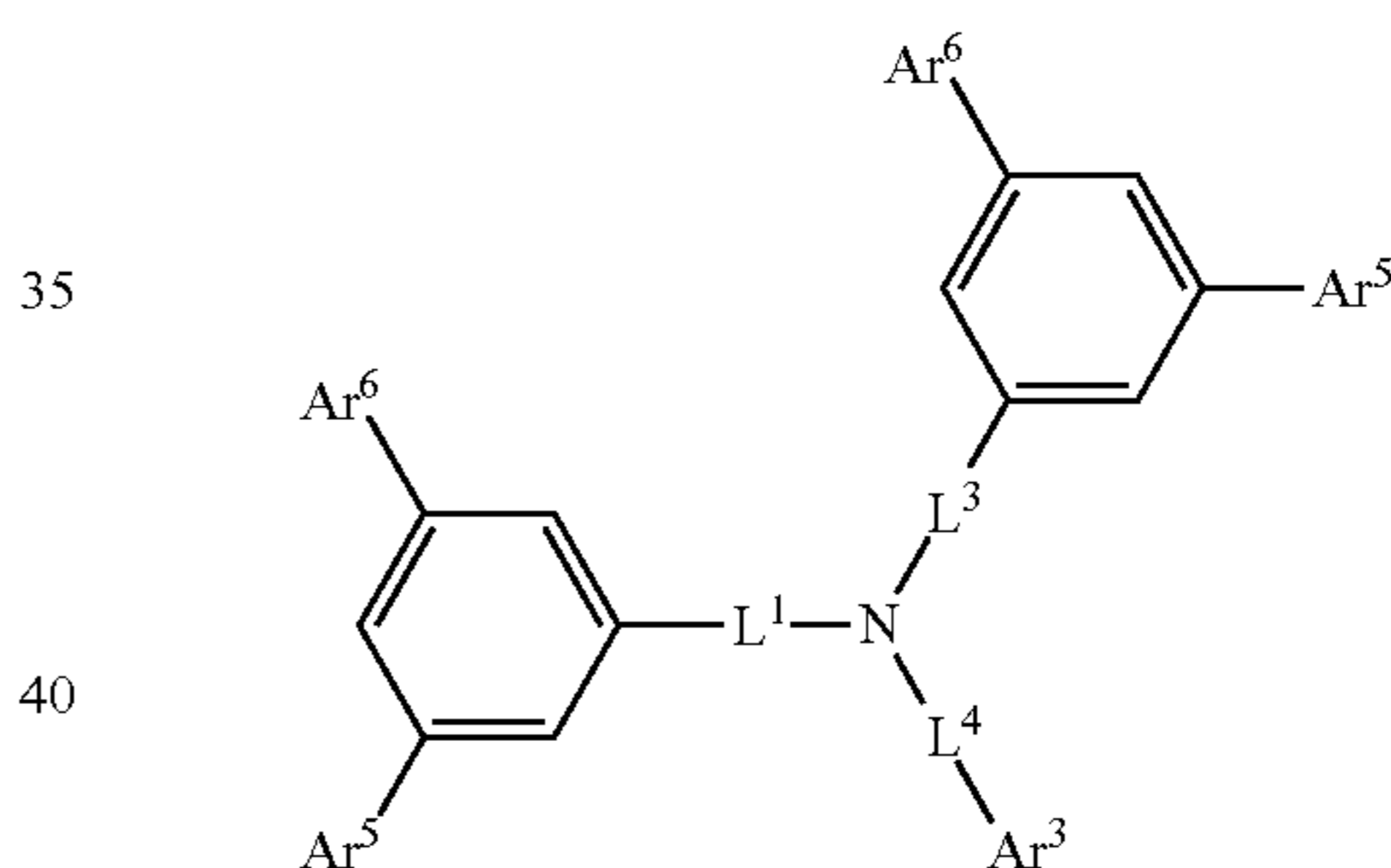
20 The first host compound represented by Formula (1) is represented by any one of the following Formulas (24) to (26).

Formula (20)



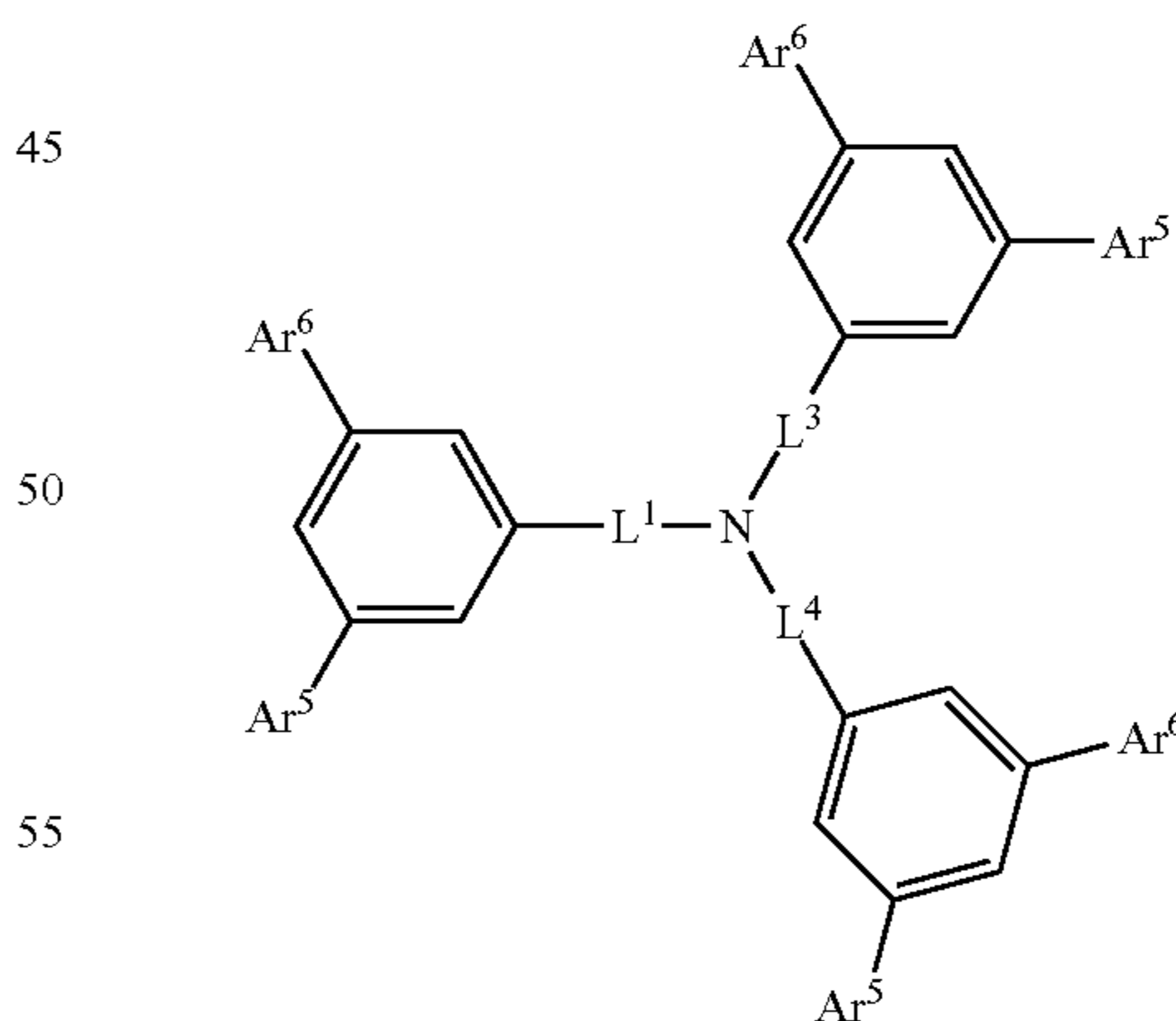
Formula (24)

Formula (21)



Formula (25)

Formula (22)



Formula (26)

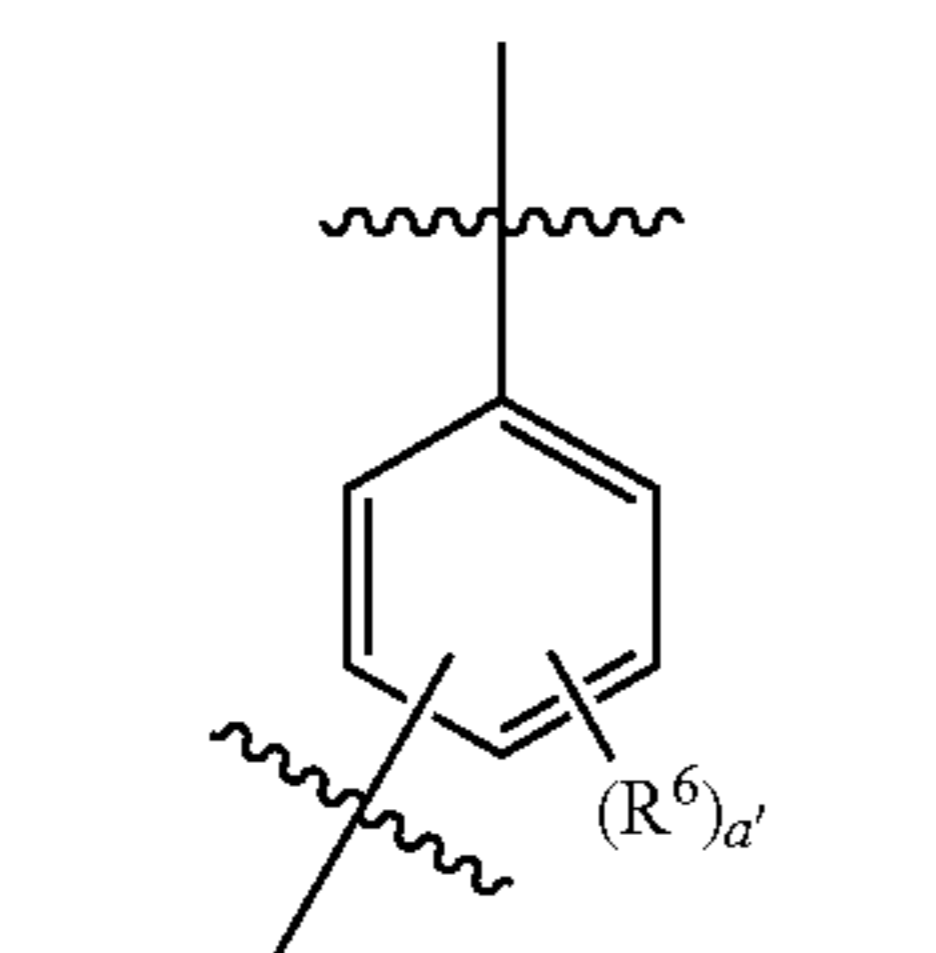
60 {In Formulas (24) to (26),  
 1)  $L^1$ ,  $L^3$ ,  $L^4$ ,  $Ar^2$  and  $Ar^3$  are the same as defined in Formula (1),

2)  $Ar^5$  and  $Ar^6$  are each independently selected from the group consisting of a  $C_6$ - $C_{60}$  aryl group; a  $C_2$ - $C_{60}$  heterocyclic group including at least one heteroatom of O, N, S, Si and P; a fused ring group of a  $C_3$ - $C_{60}$  aliphatic ring and a  $C_6$ - $C_{60}$  aromatic ring; a  $C_1$ - $C_{50}$  alkyl group; a  $C_2$ - $C_{20}$  alkenyl

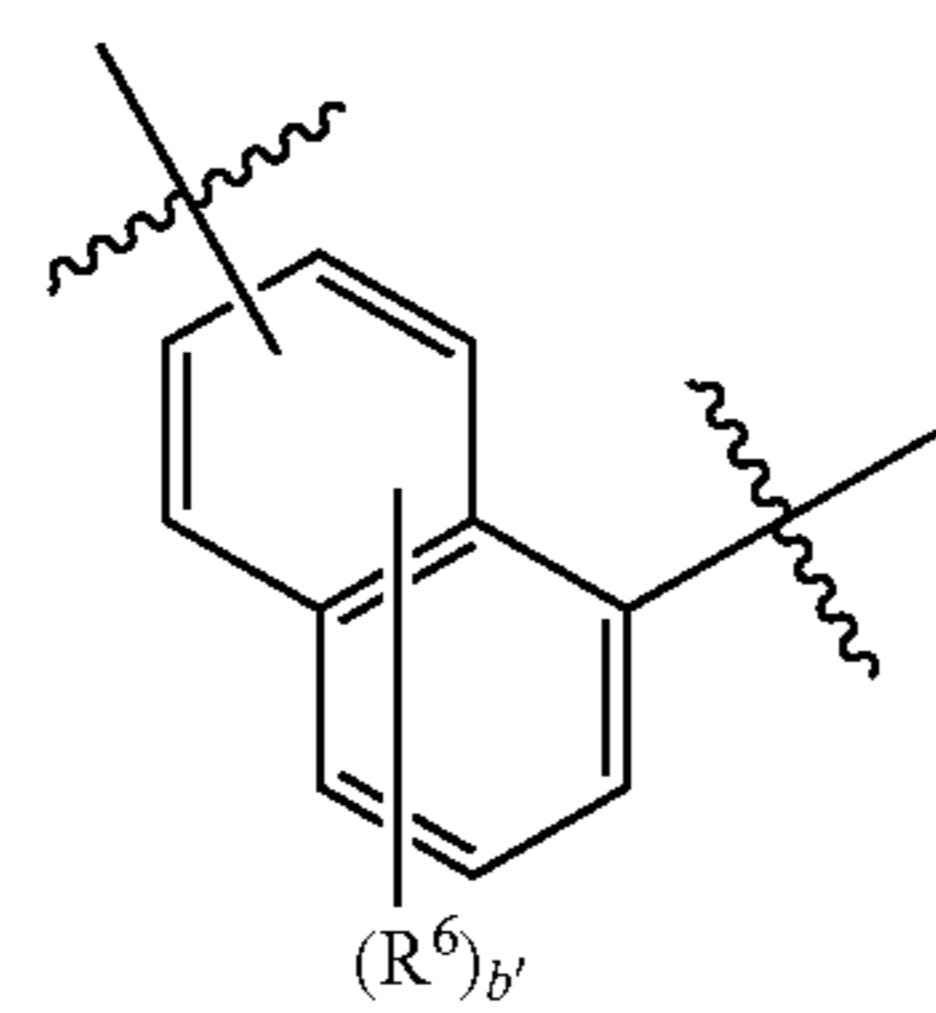
17

group; a C<sub>2</sub>-C<sub>20</sub> alkynyl group; a C<sub>1</sub>-C<sub>30</sub> alkoxy group; a C<sub>6</sub>-C<sub>30</sub> aryloxy group; and —L<sup>1</sup>-N(R<sub>a</sub>)(R<sub>b</sub>)}.

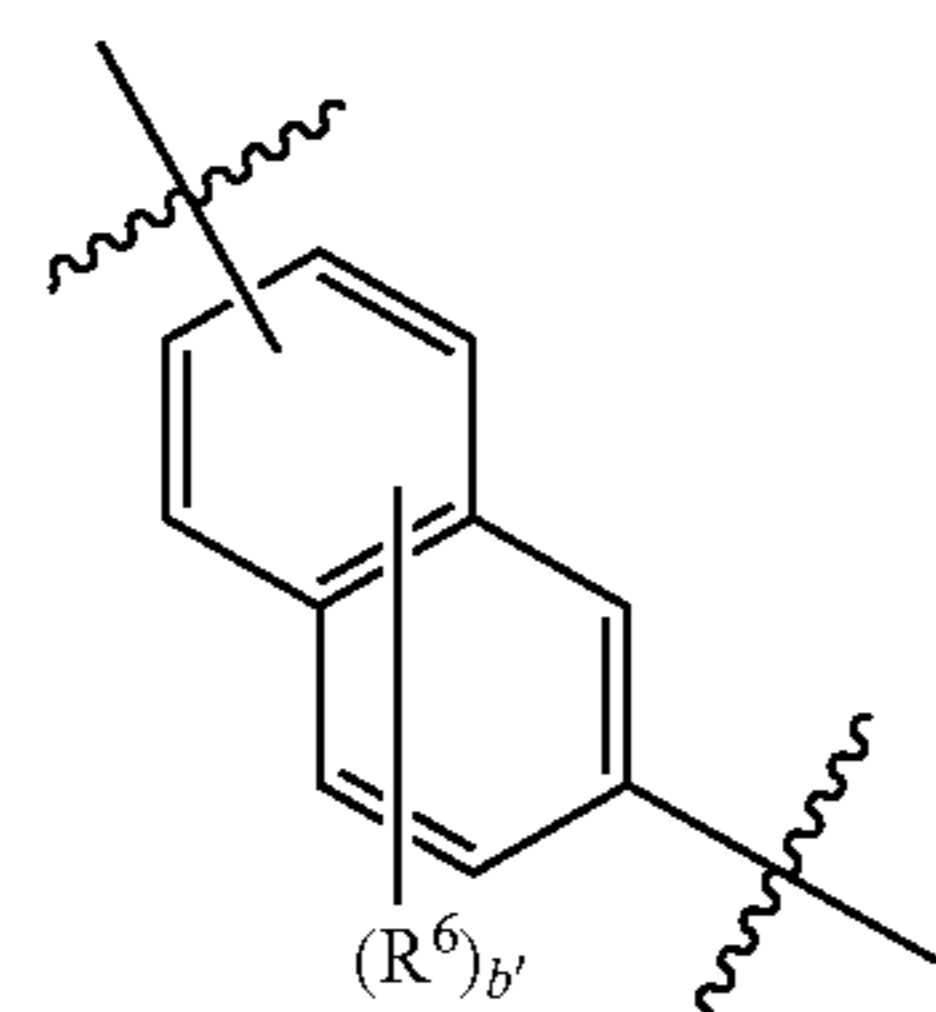
In Formula (1) of the present invention, L<sup>1</sup>, L<sup>3</sup> and L<sup>4</sup> are selected from the group consisting of the following Formulas (A-1) to (A-12).



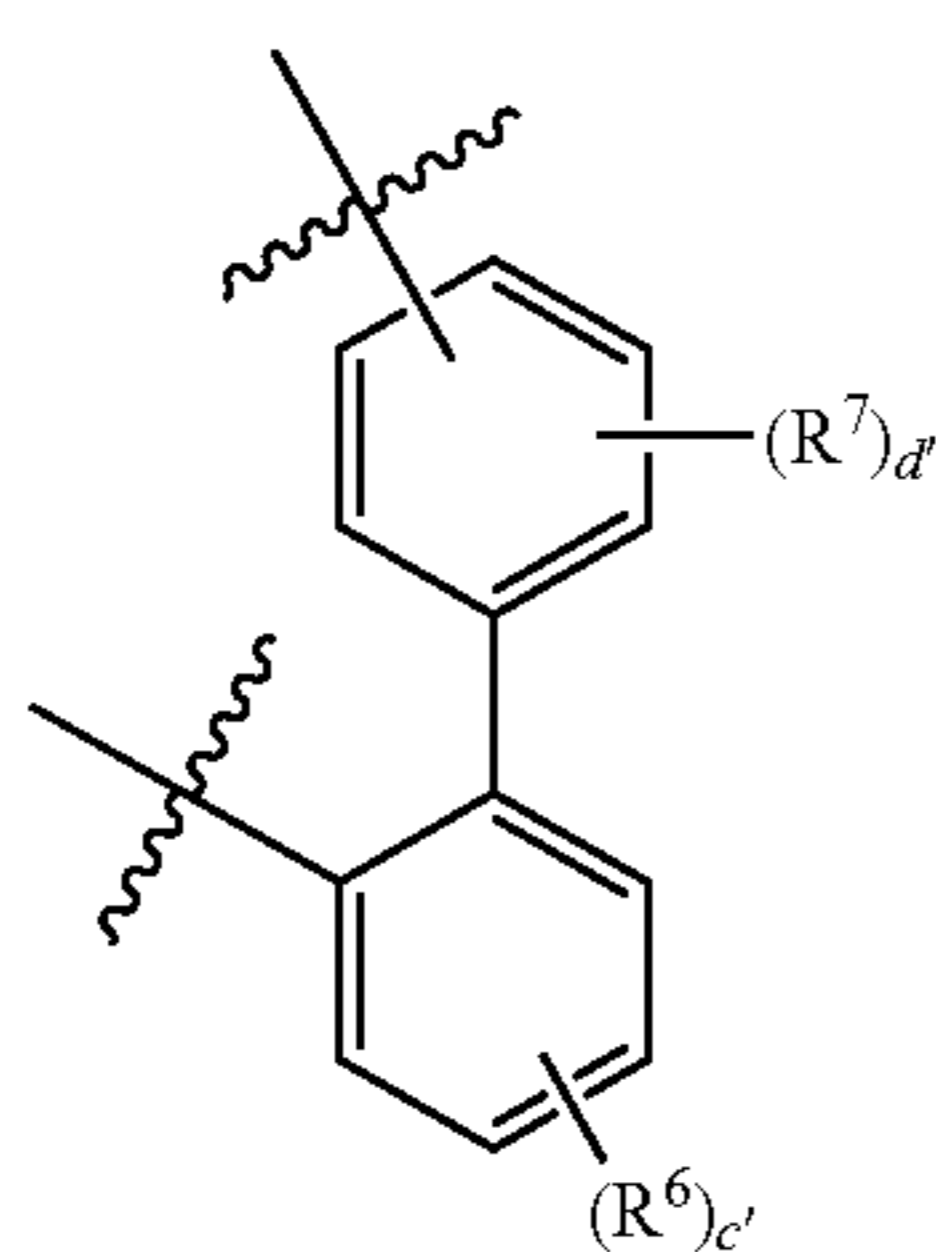
(A-1)



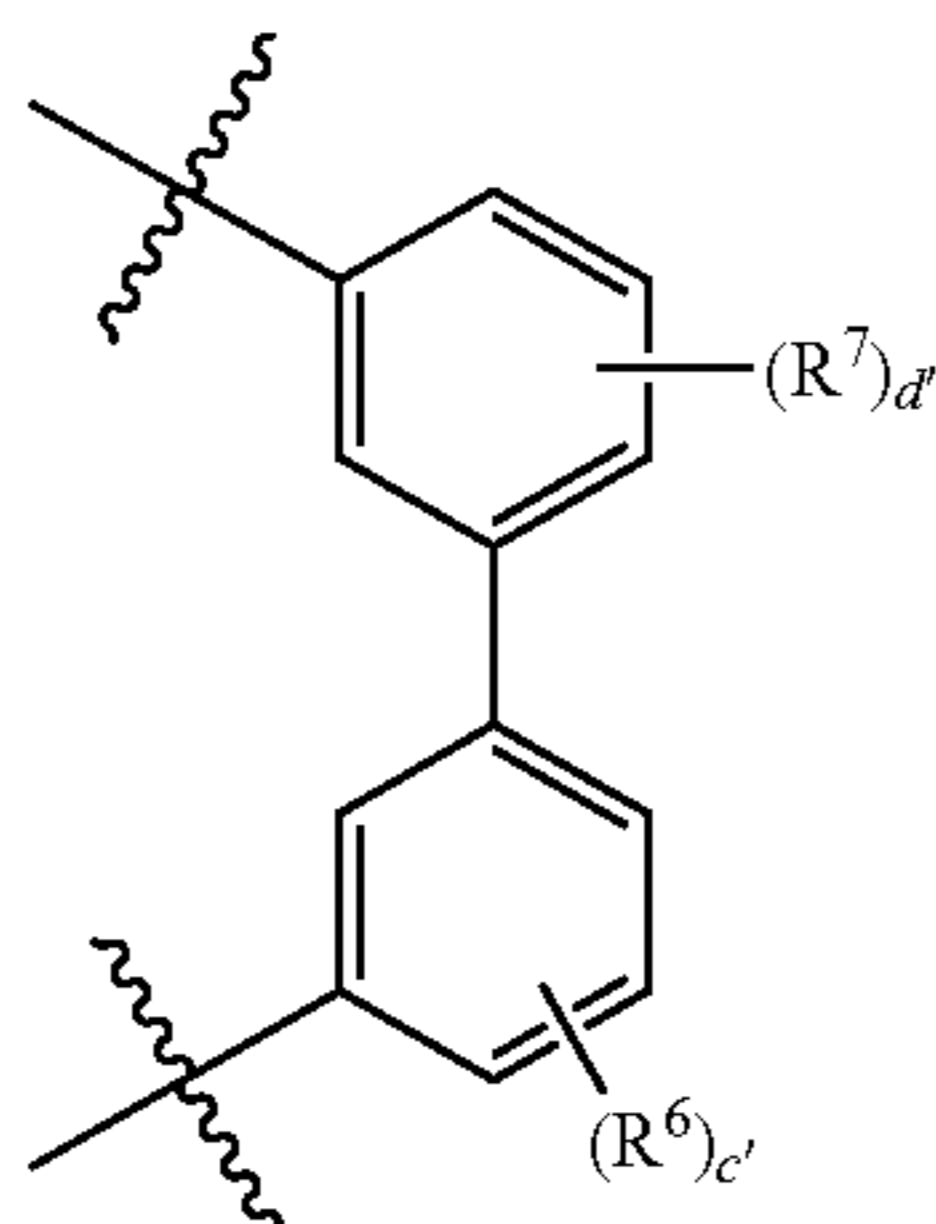
(A-2)



(A-3)



(A-4)

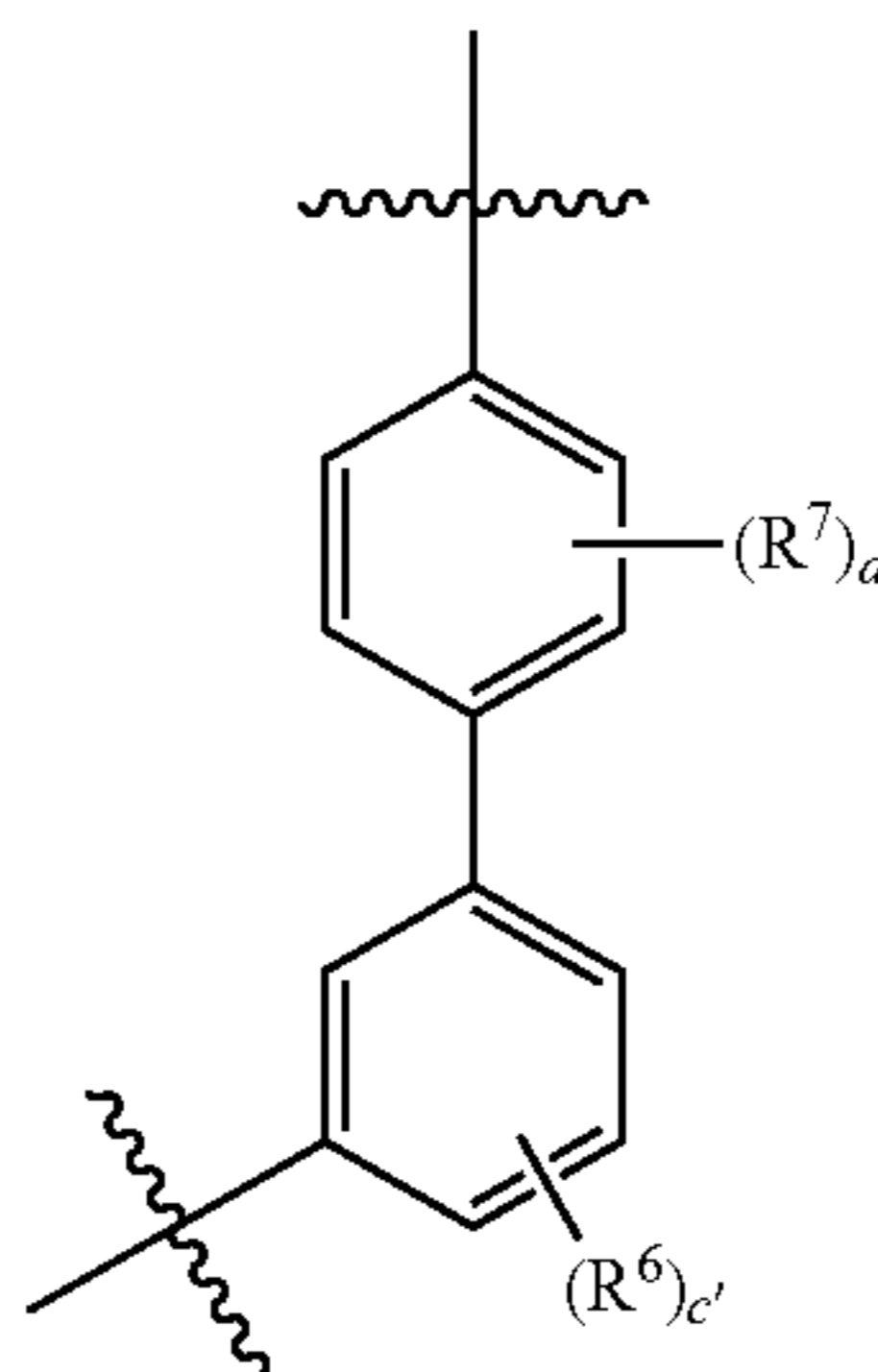


(A-5)

18

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(A-6)

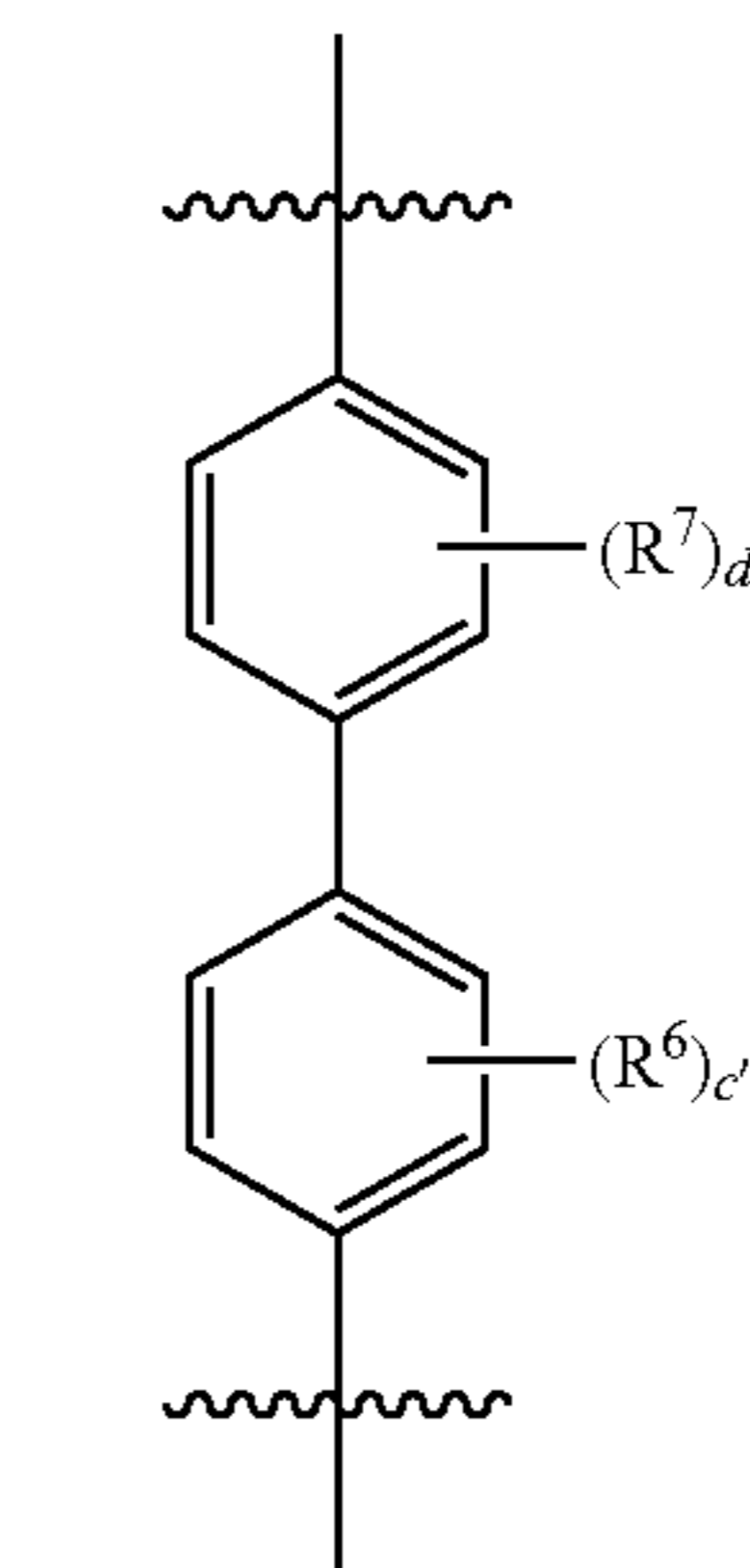


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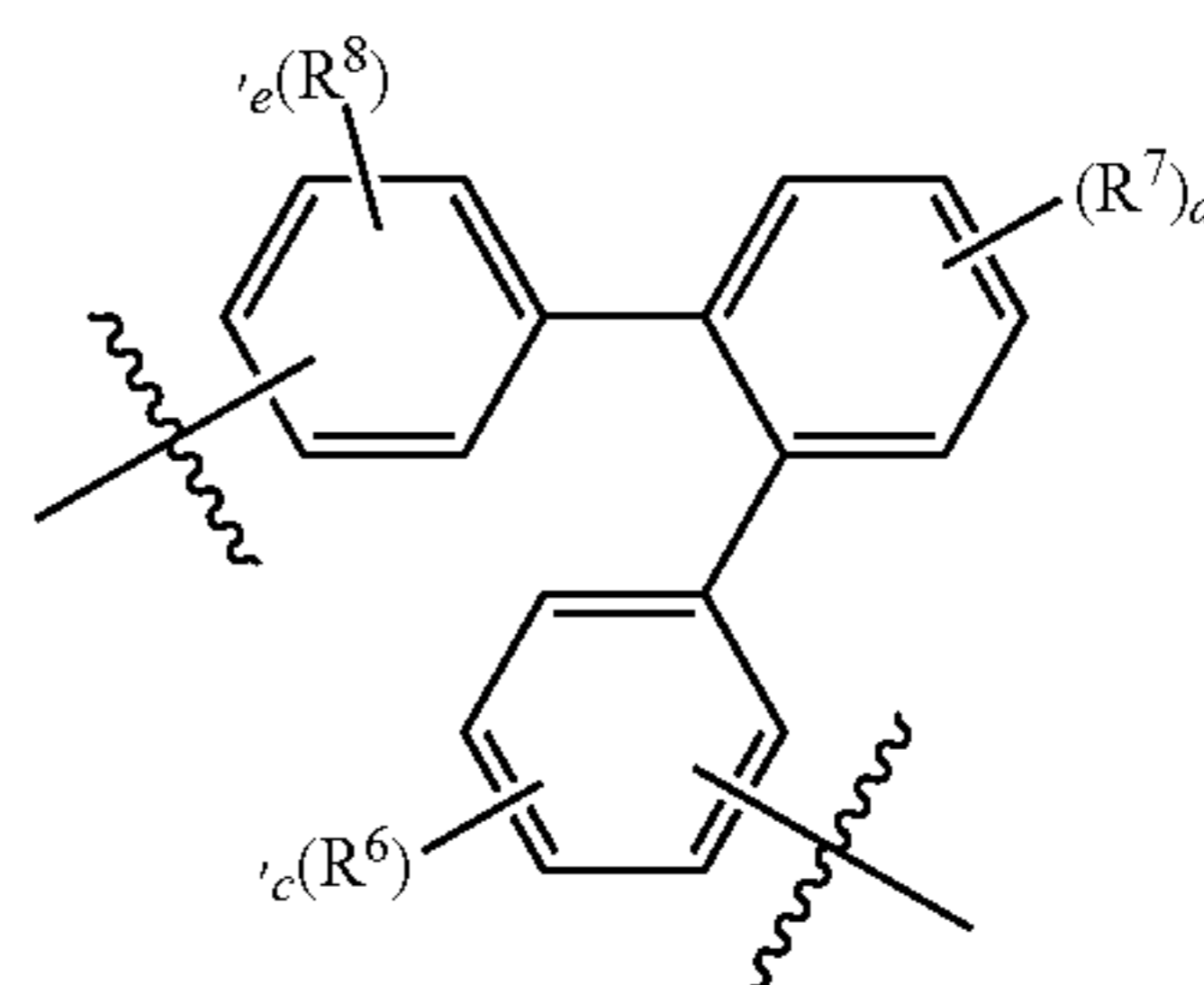
(A-7)



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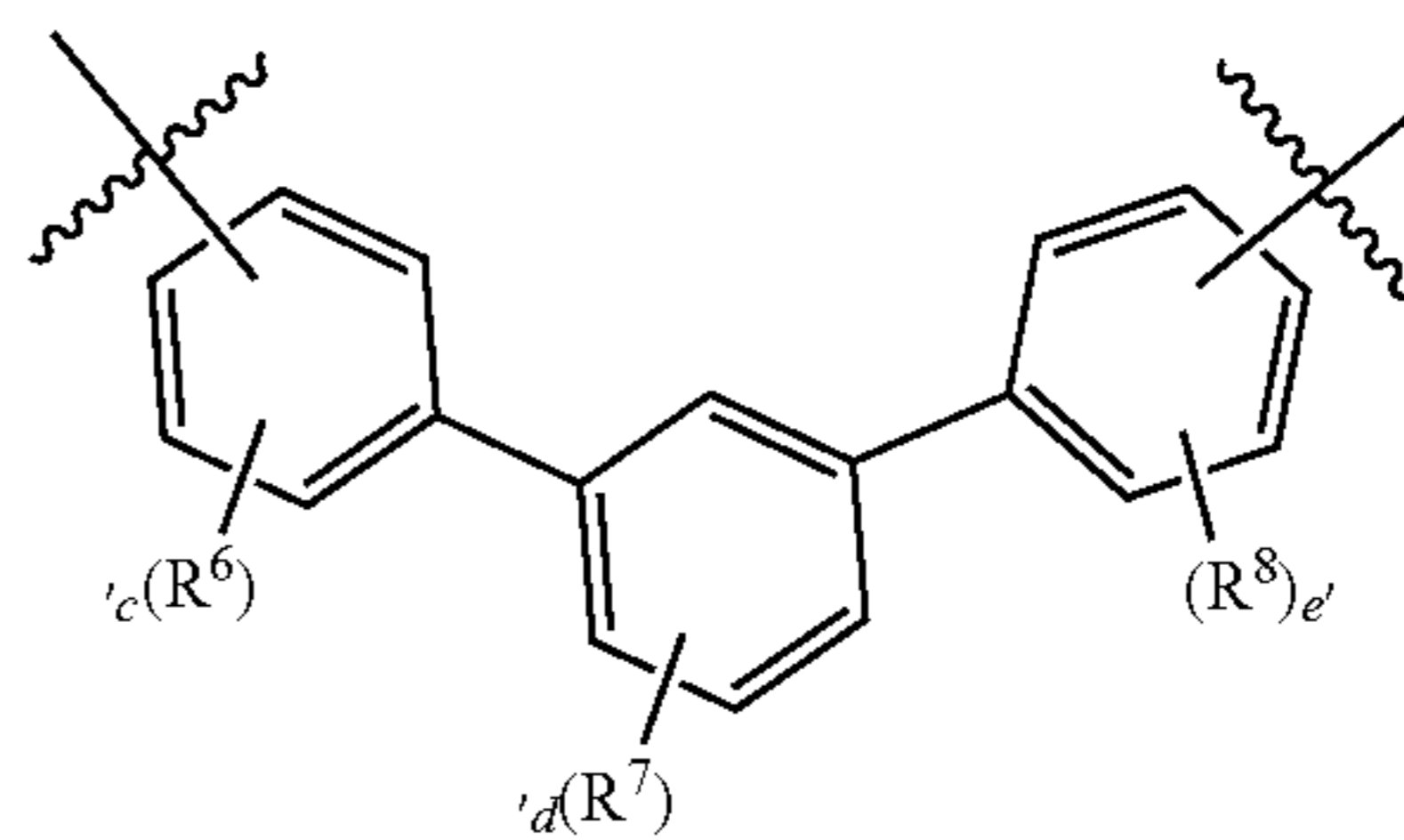
(A-8)



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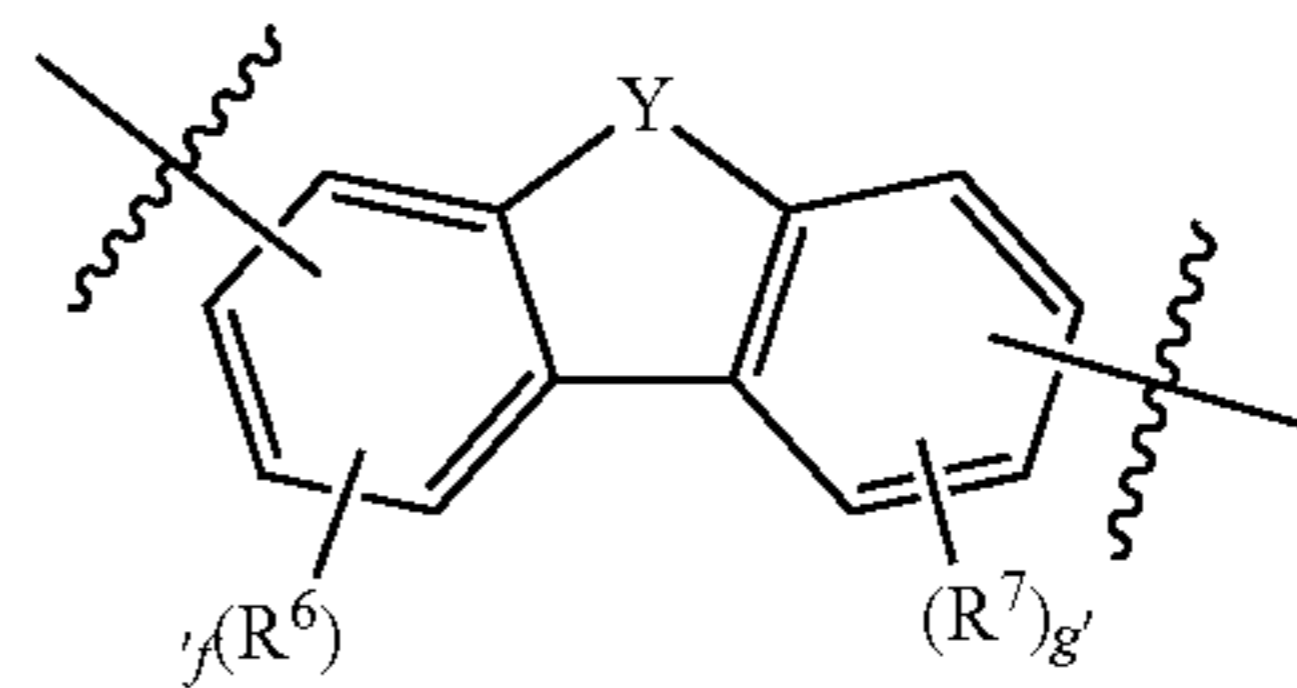
(A-9)



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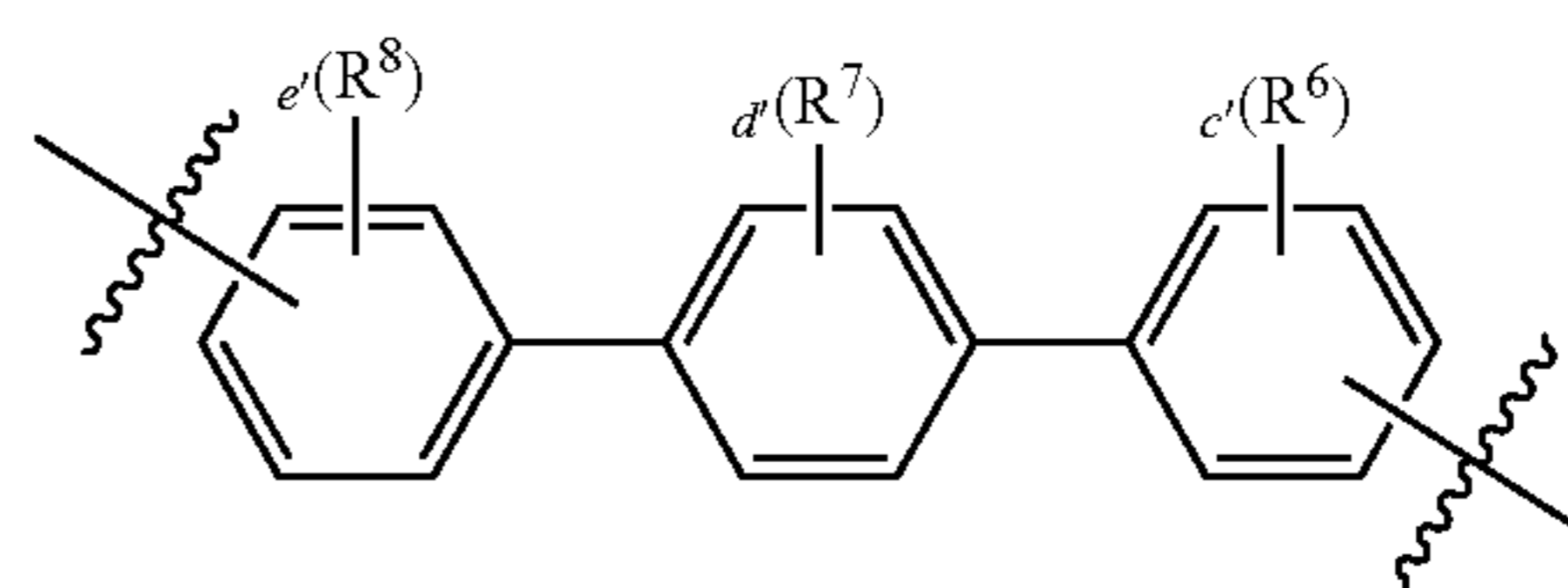
(A-10)



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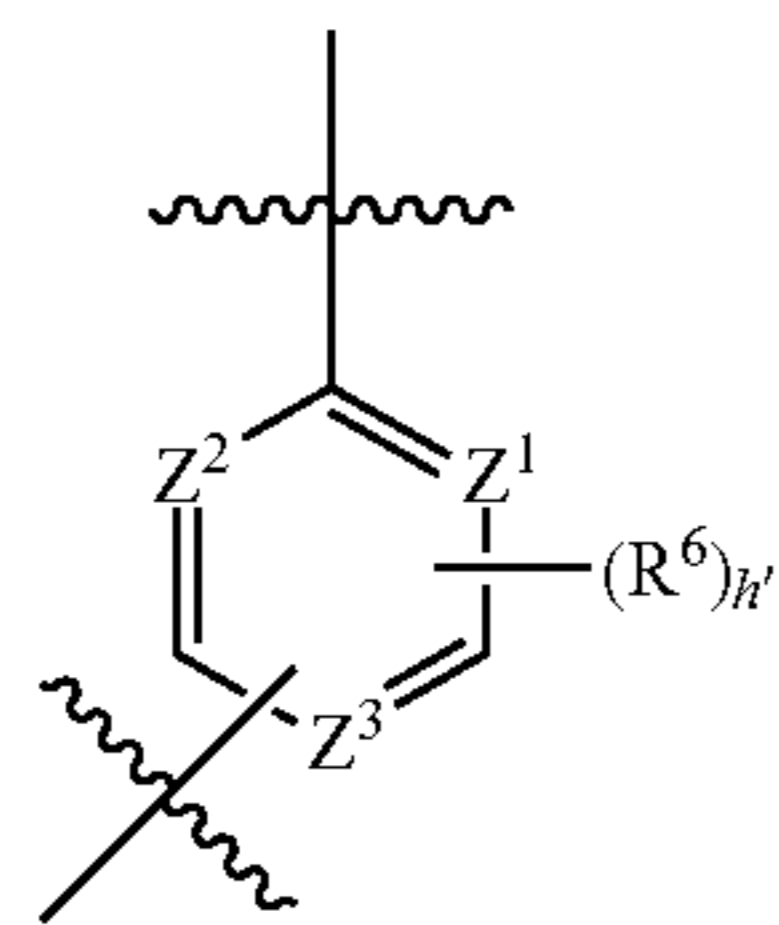
(A-11)



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19

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(A-12)

{In Formulas (A-1) to (A-12),

1) a', c', d' and e' are integers of 0 to 4, and b' is an integer of 0 to 6, and f' and g' are integers of 0 to 3, and h' is an integer of 0 to 1,

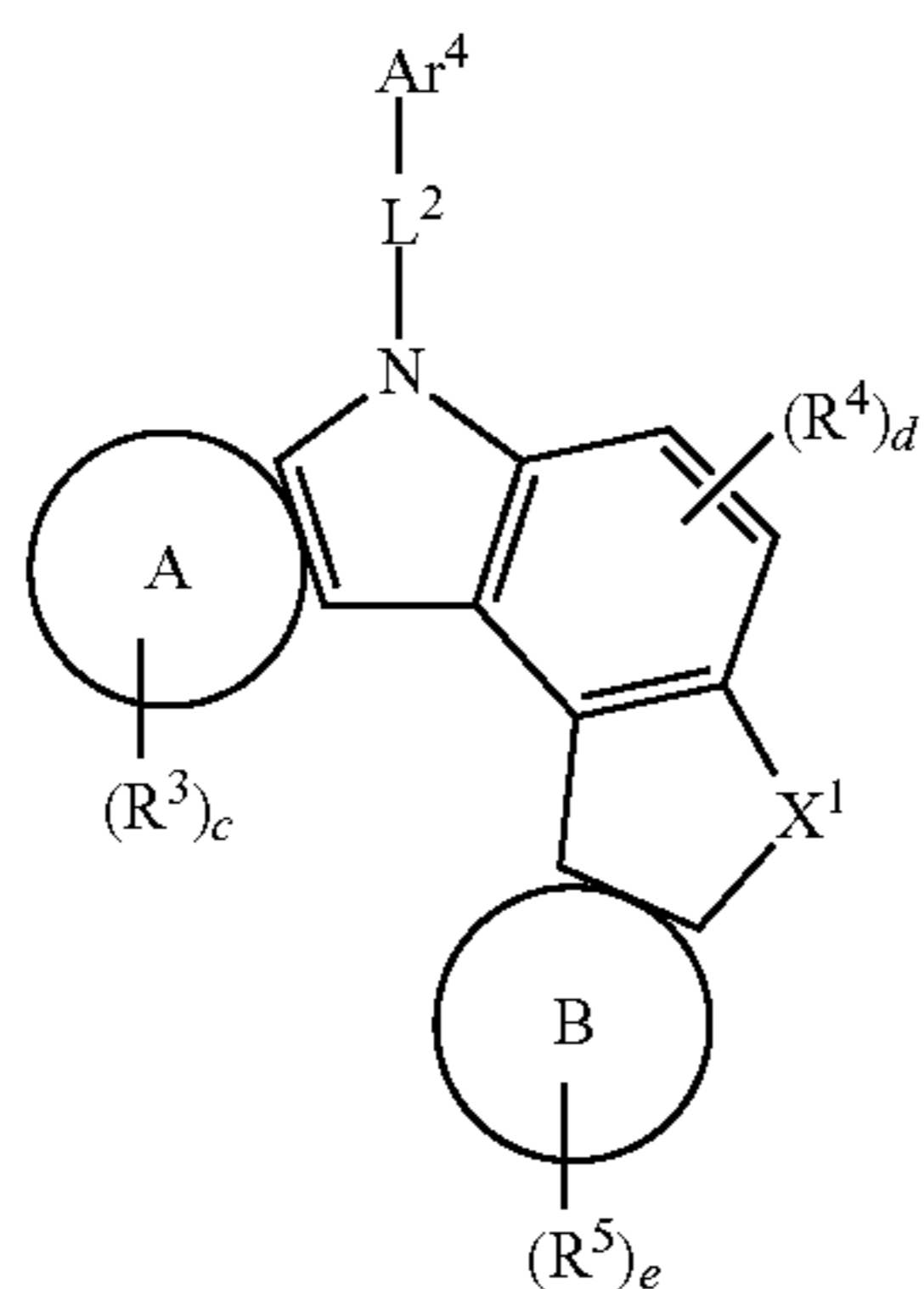
2) R<sup>6</sup>, R<sup>7</sup> and R<sup>8</sup> are the same or different from each other, and are each independently selected from the group consisting of deuterium; halogen; a C<sub>6</sub>-C<sub>60</sub> aryl group; a fluorenyl group; a C<sub>2</sub>-C<sub>60</sub> heterocyclic group including at least one heteroatom of O, N, S, Si and P; a fused ring group of a C<sub>3</sub>-C<sub>60</sub> aliphatic ring and a C<sub>6</sub>-C<sub>60</sub> aromatic ring; a C<sub>1</sub>-C<sub>50</sub> alkyl group; a C<sub>2</sub>-C<sub>20</sub> alkenyl group; a C<sub>2</sub>-C<sub>20</sub> alkynyl group; a C<sub>1</sub>-C<sub>30</sub> alkoxy group; a C<sub>6</sub>-C<sub>30</sub> aryloxy group; and —L'<sup>1</sup>-N(R<sub>a</sub>)(R<sub>b</sub>); or wherein f' and g' are two or more, R<sup>6</sup>, R<sup>7</sup> and R<sup>8</sup> are each in plural being the same as or different from each other, and a plurality of R<sup>6</sup> or a plurality of R<sup>7</sup> or adjacent R<sup>6</sup> and R<sup>7</sup> may combine to each other to form an aromatic or a heteroaromatic ring,

3) Y is NR', O, S or CR'R'', and R' and R'' are the same as defined in Formula (2),

4) Z<sup>1</sup>, Z<sup>2</sup> and Z<sup>3</sup> are CR' or N, and at least one is N.}

In one embodiment of the present invention, at least one of L<sup>1</sup>, L<sup>3</sup>, and L<sup>4</sup> in Formula (1) is a phenyl group and is substituted with an m (meta)-position.

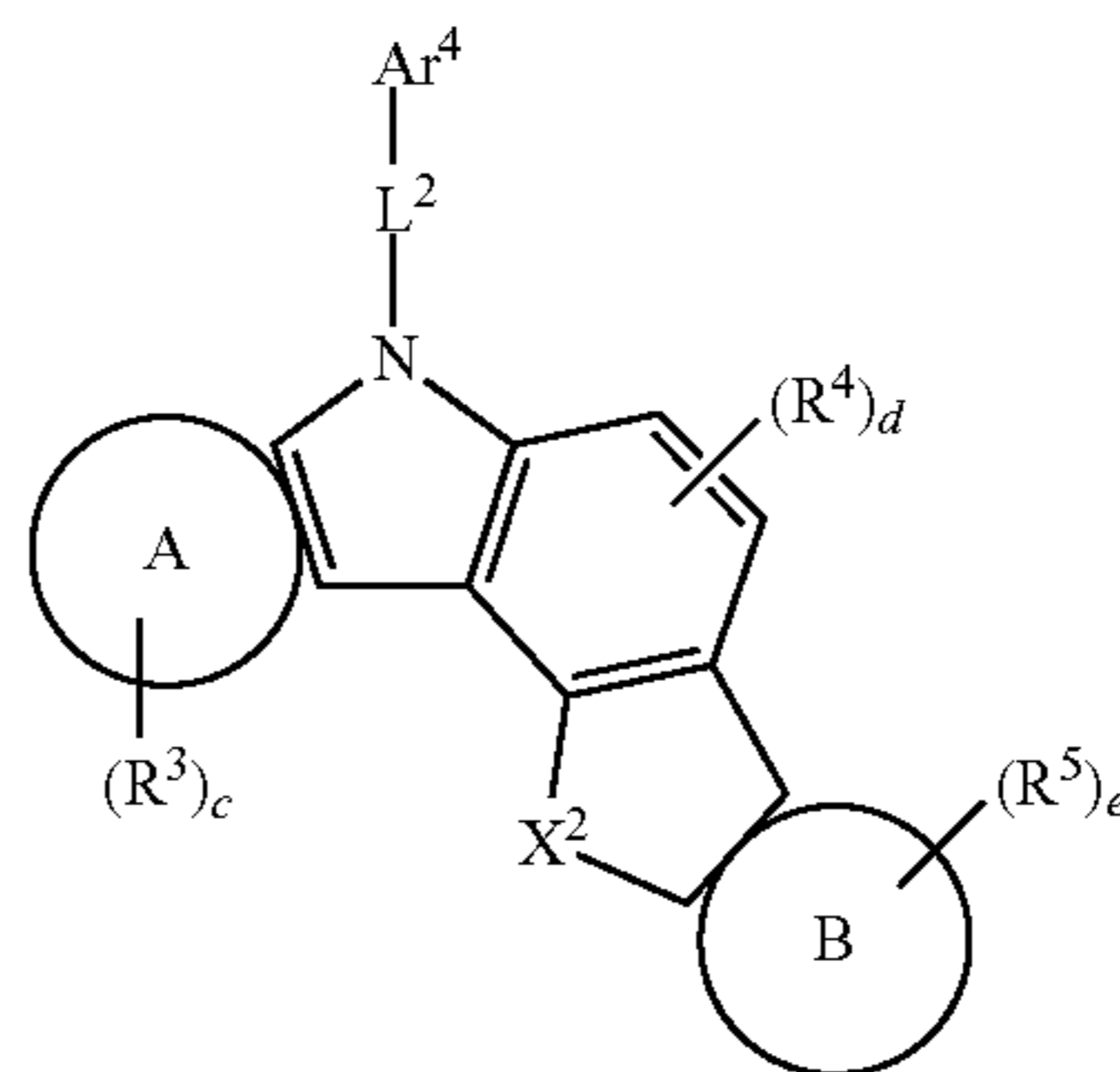
The present invention provides an organic electric element wherein the second host compound represented by Formula (2) comprises a compound represented by the following Formula (27) or (28).



Formula (27)

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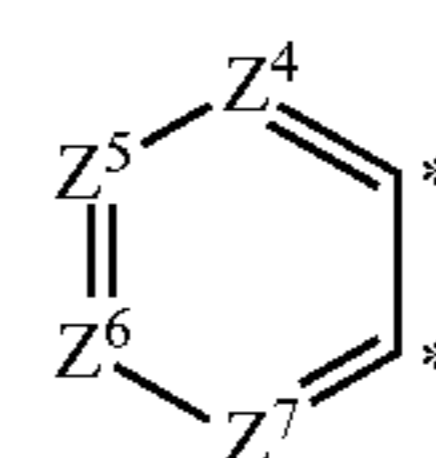


Formula (28)

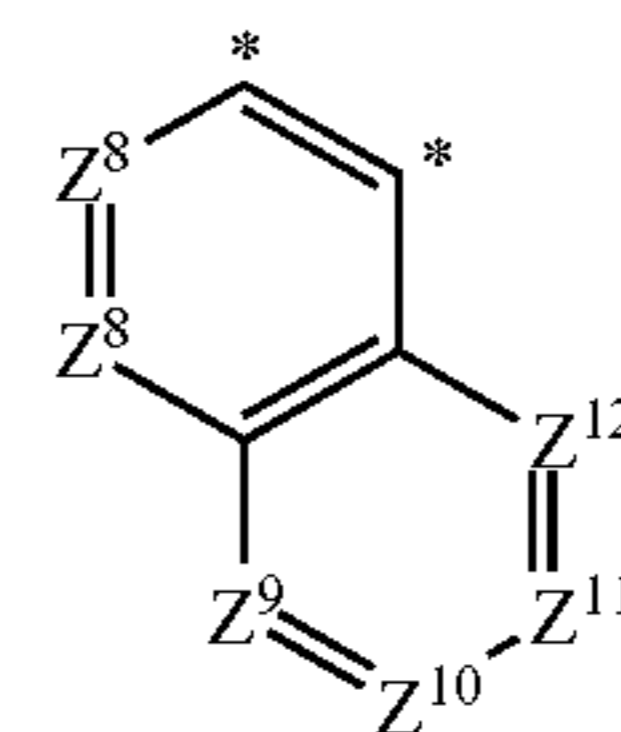
{In Formulas (27) and (28),

R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, Ar<sup>4</sup>, L<sup>2</sup>, c, d, e, A, B, X<sup>1</sup> and X<sup>2</sup> are the same as defined in Formula (2).}

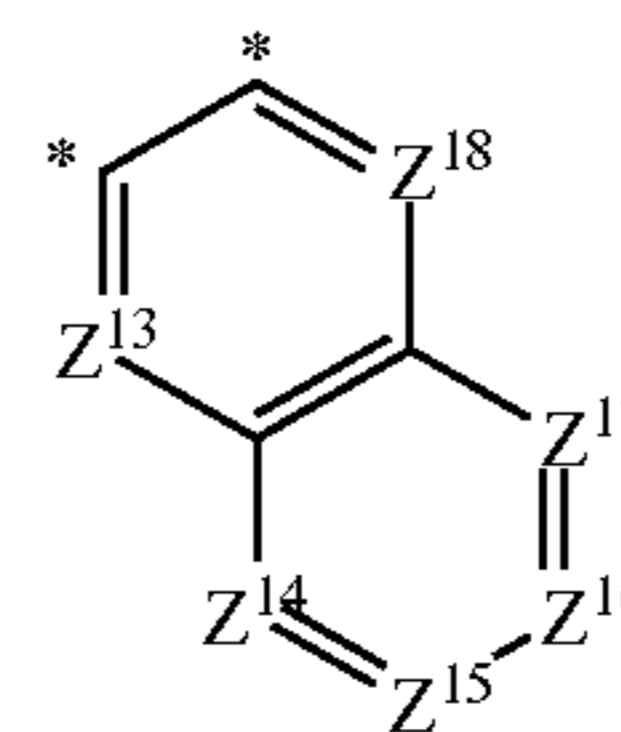
The present invention also provides an organic electric element comprising a compound wherein A and B in Formula (2) are selected from the group consisting of the following Formulas (B-1) to (B-7).



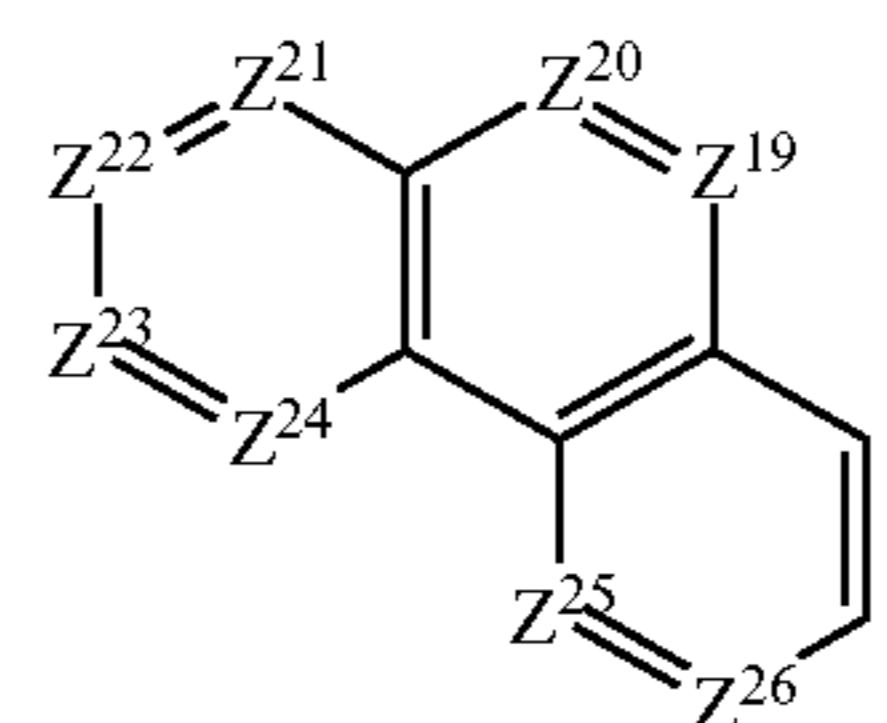
(B-1)



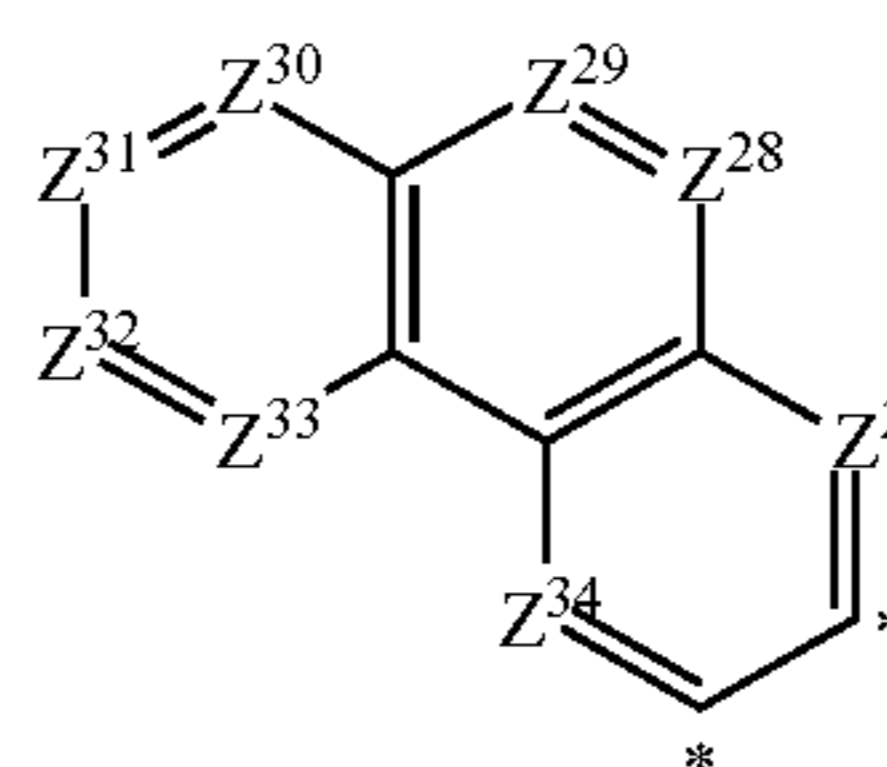
(B-2)



(B-3)



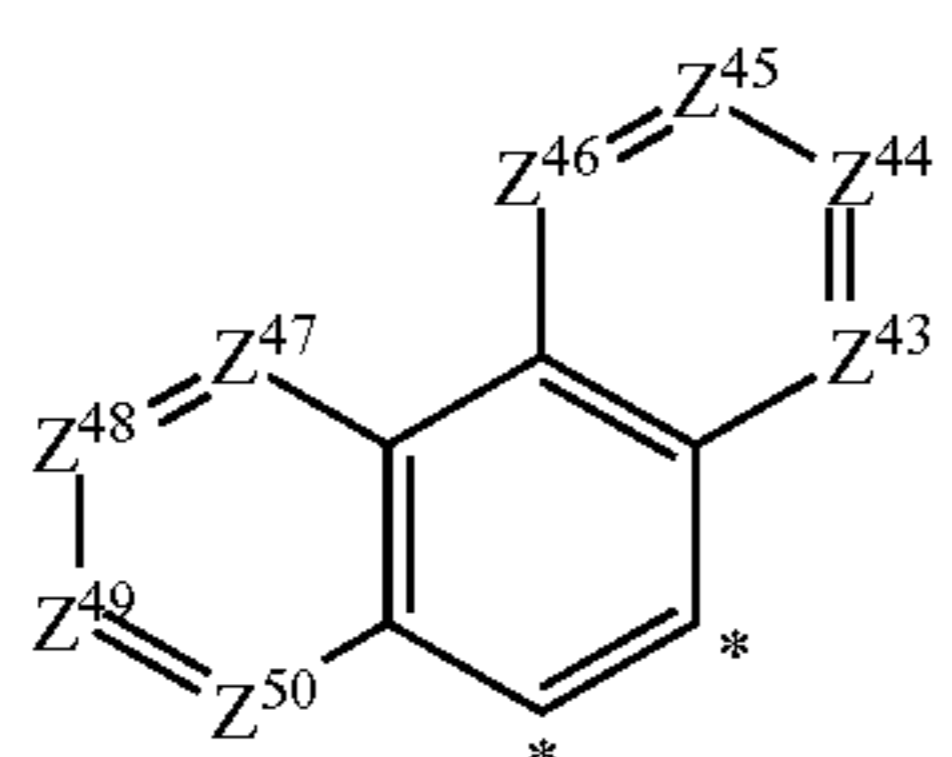
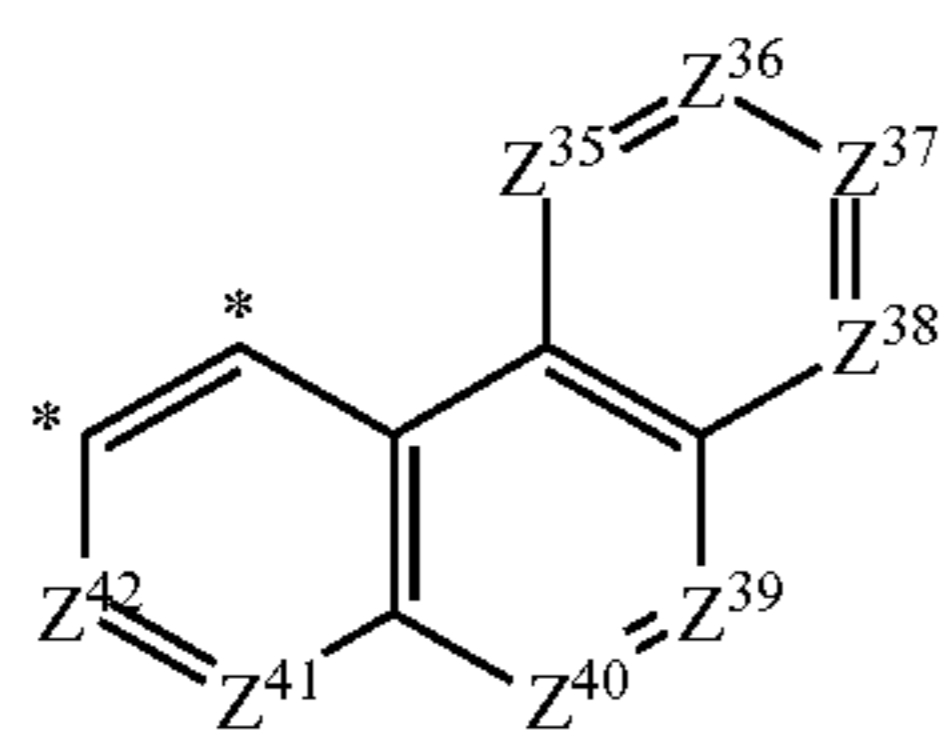
(B-4)



(B-5)

21

-continued



{In Formulas (B-1) to (B-7),

1)  $Z^4$  to  $Z^{50}$  are  $CR'$  or  $N$ ,

2)  $R'$  is the same as defined in Formula (2),

3) \* indicates the position to be condensed.}

As another example, the present invention provides a compound wherein the second host compound represented by Formula (2) includes a compound represented by any of the following Formulas (29) to (48).

(B-6)

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(B-7)

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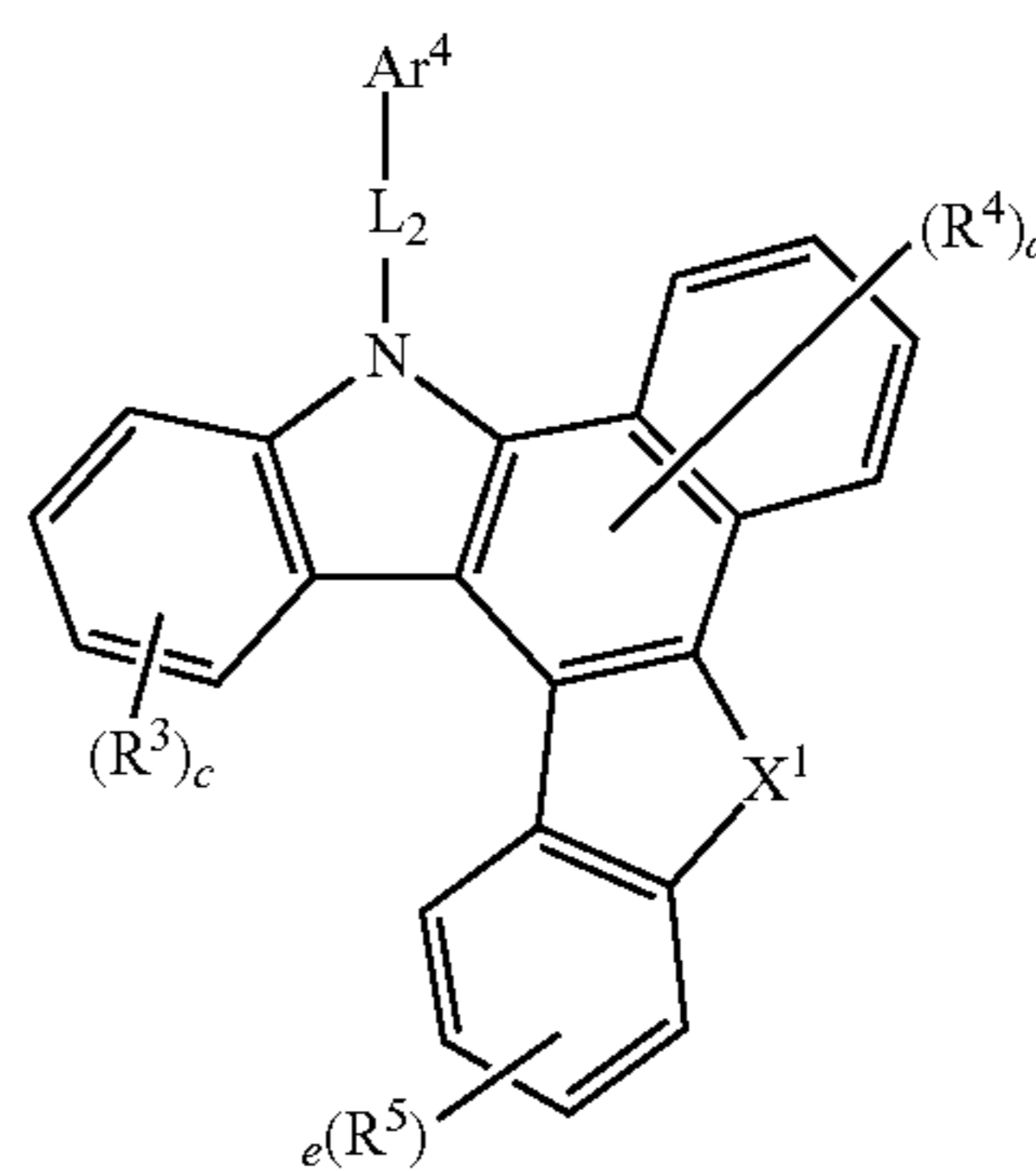
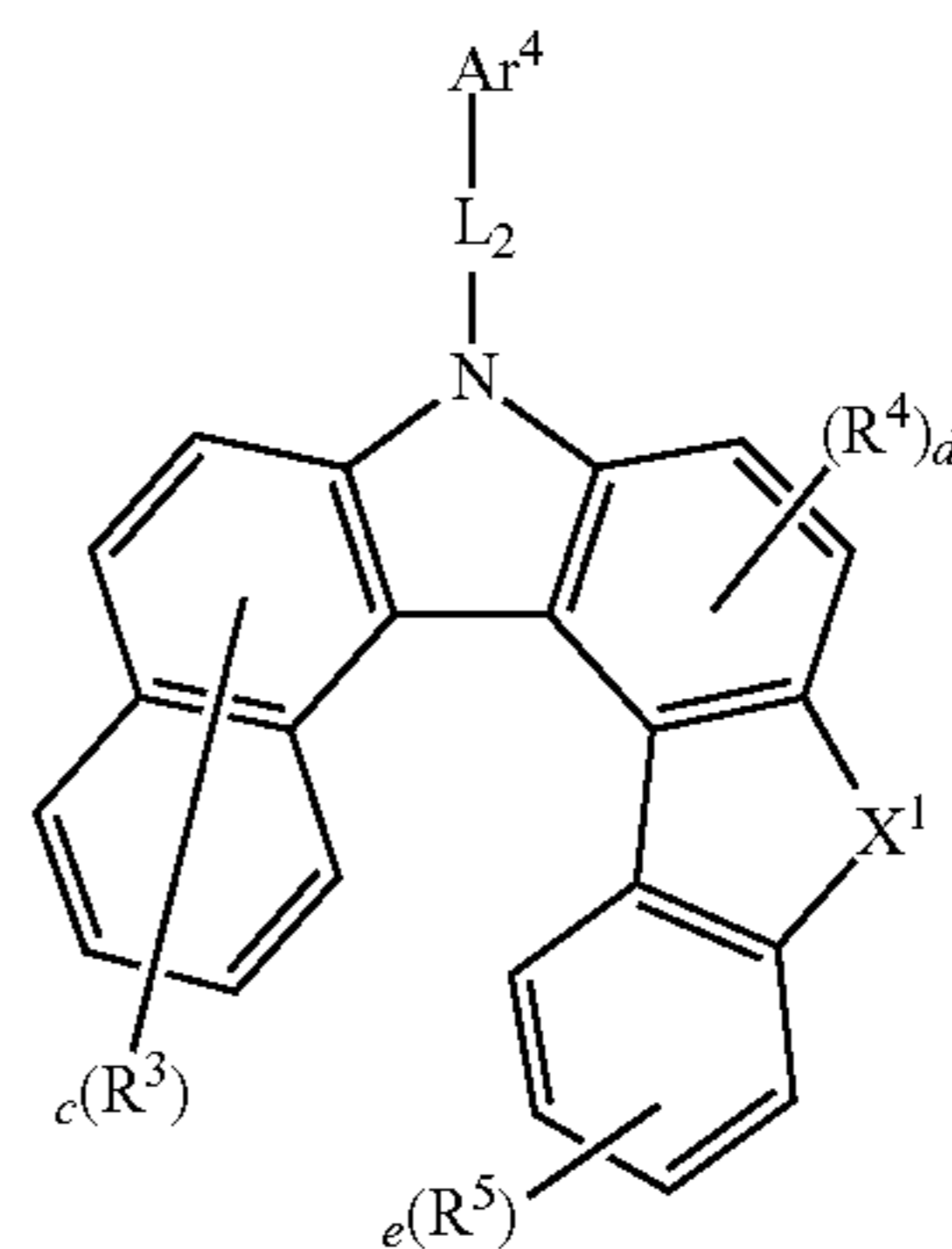
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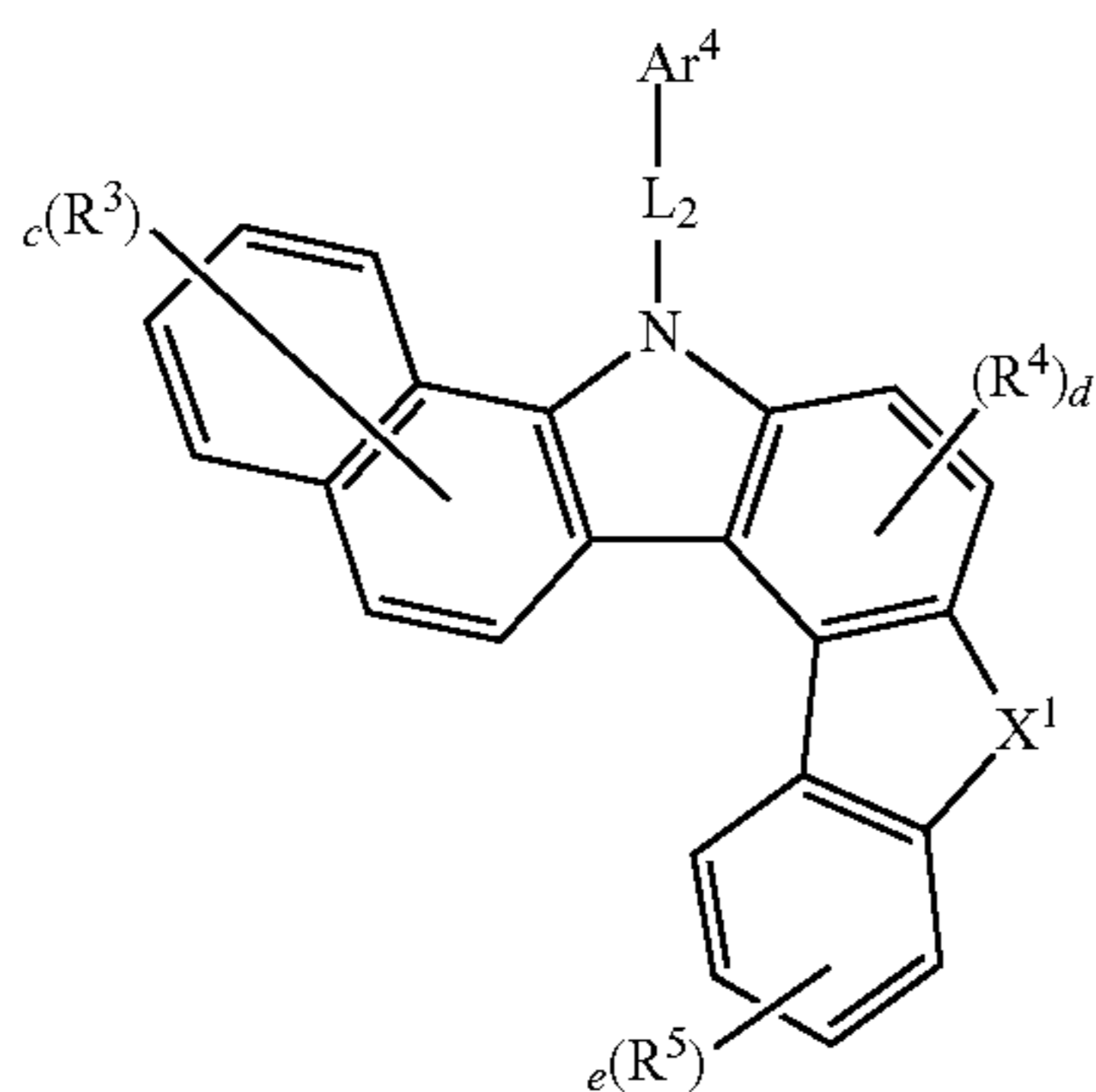


Formula (31)

Formula (32)

Formula (29)

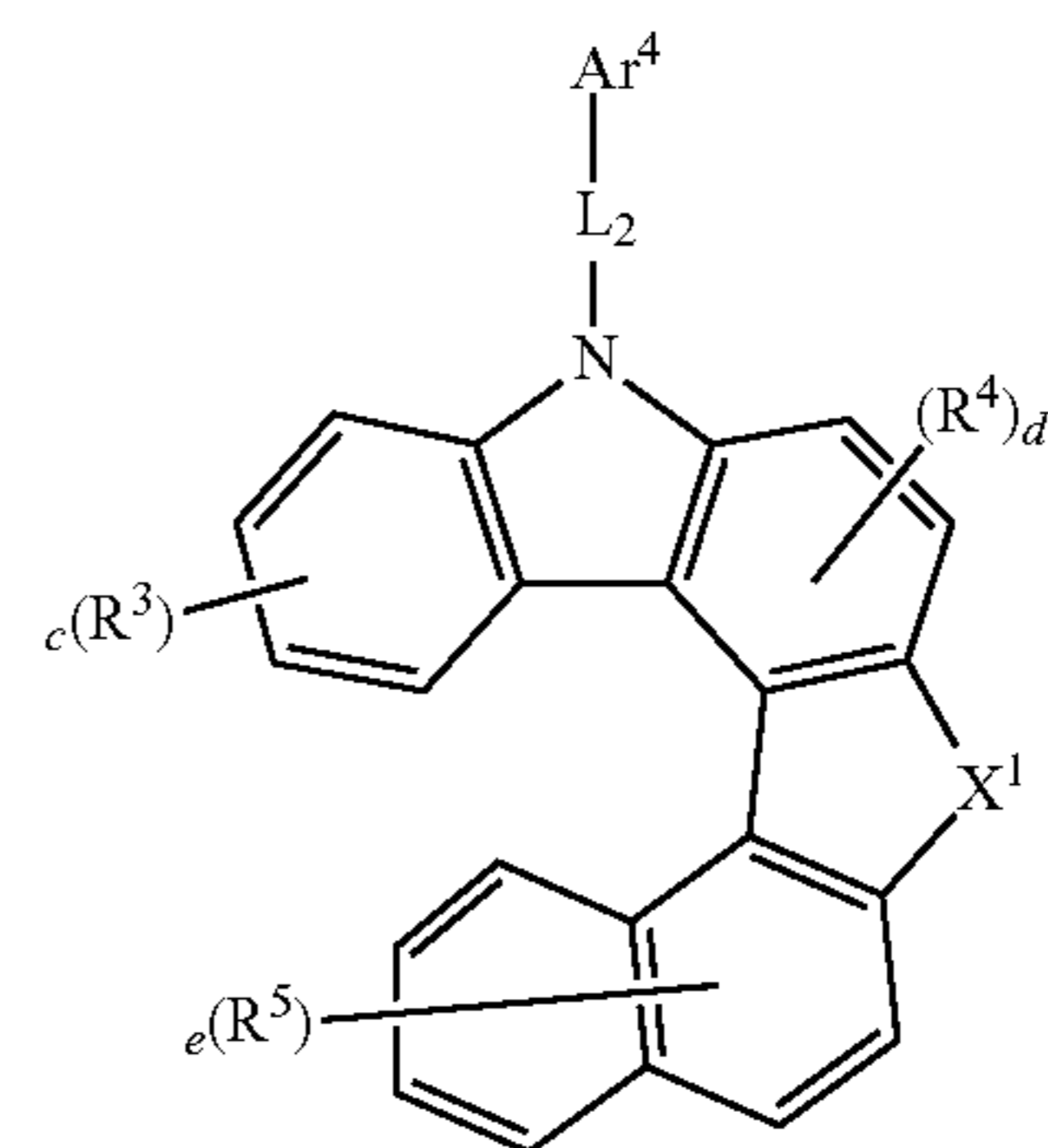
35



Formula (33)

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Formula (34)

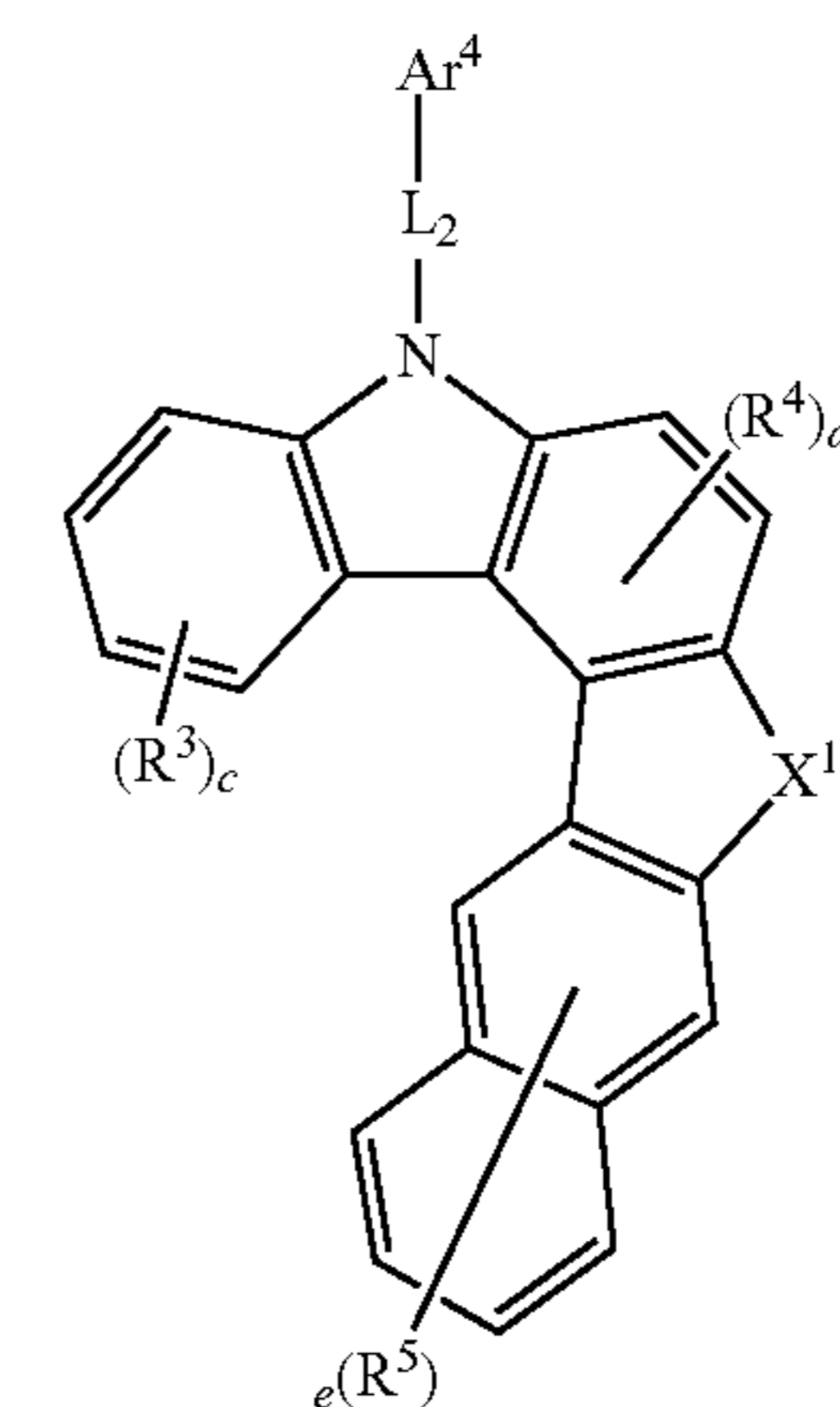
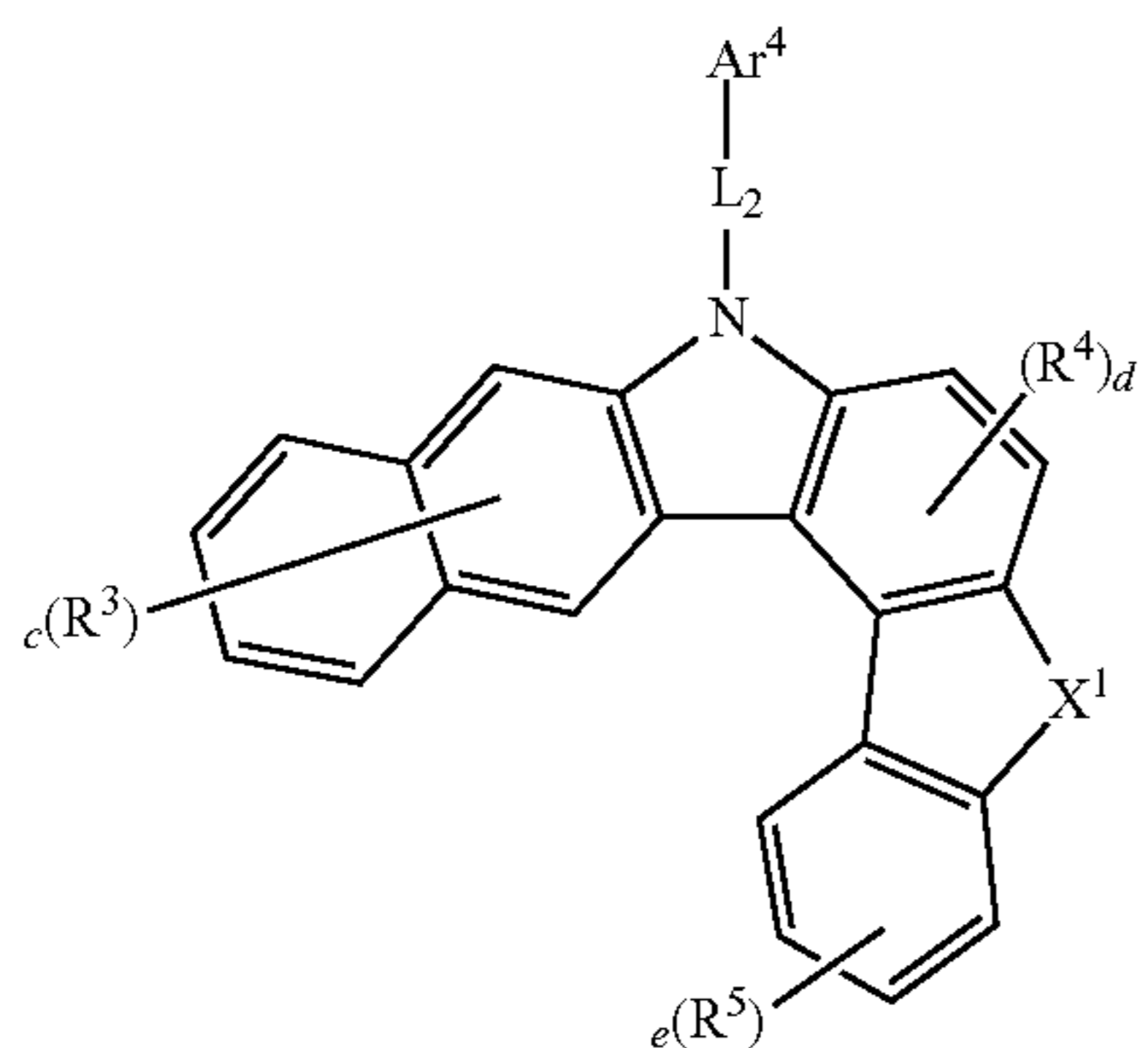
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Formula (30)

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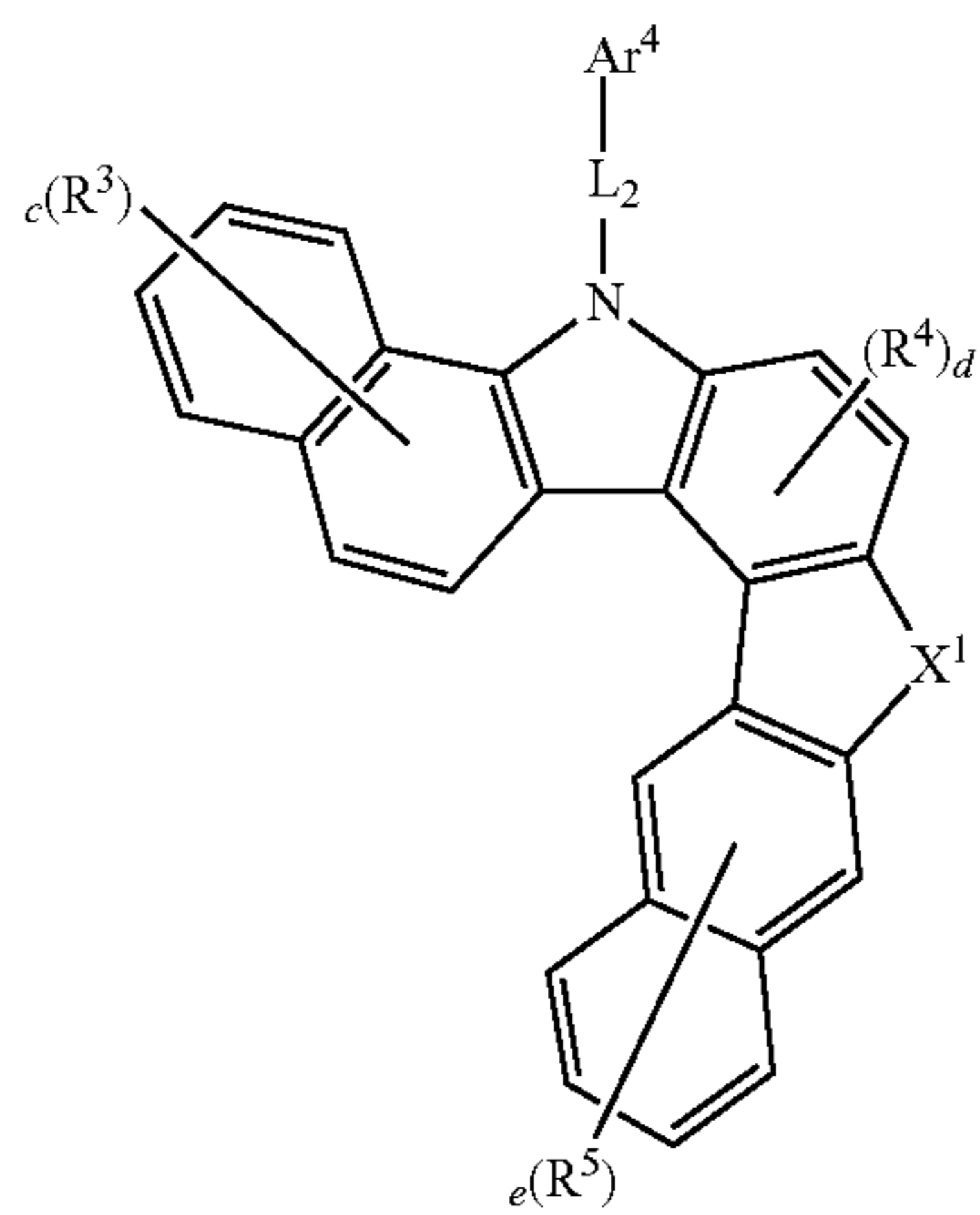
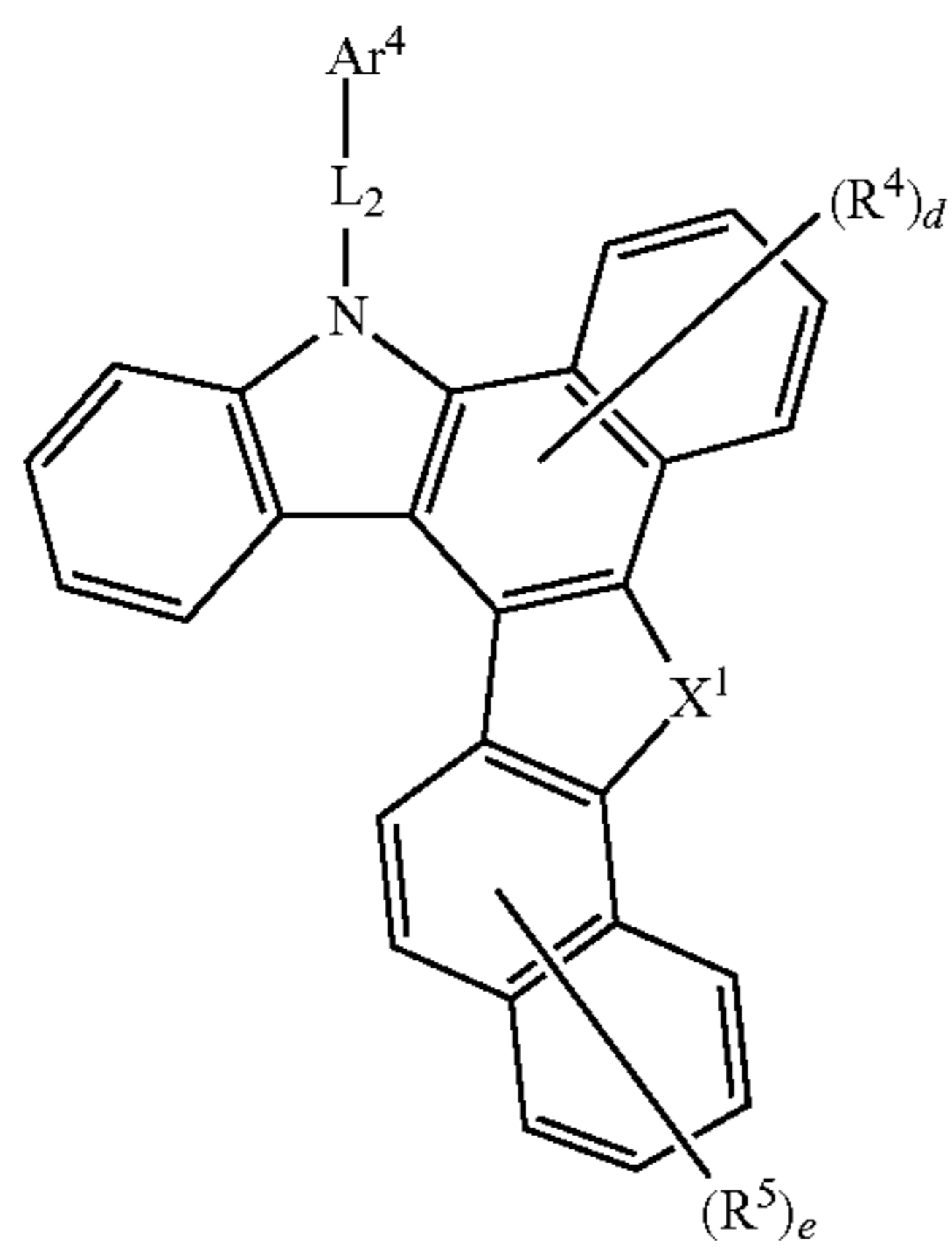
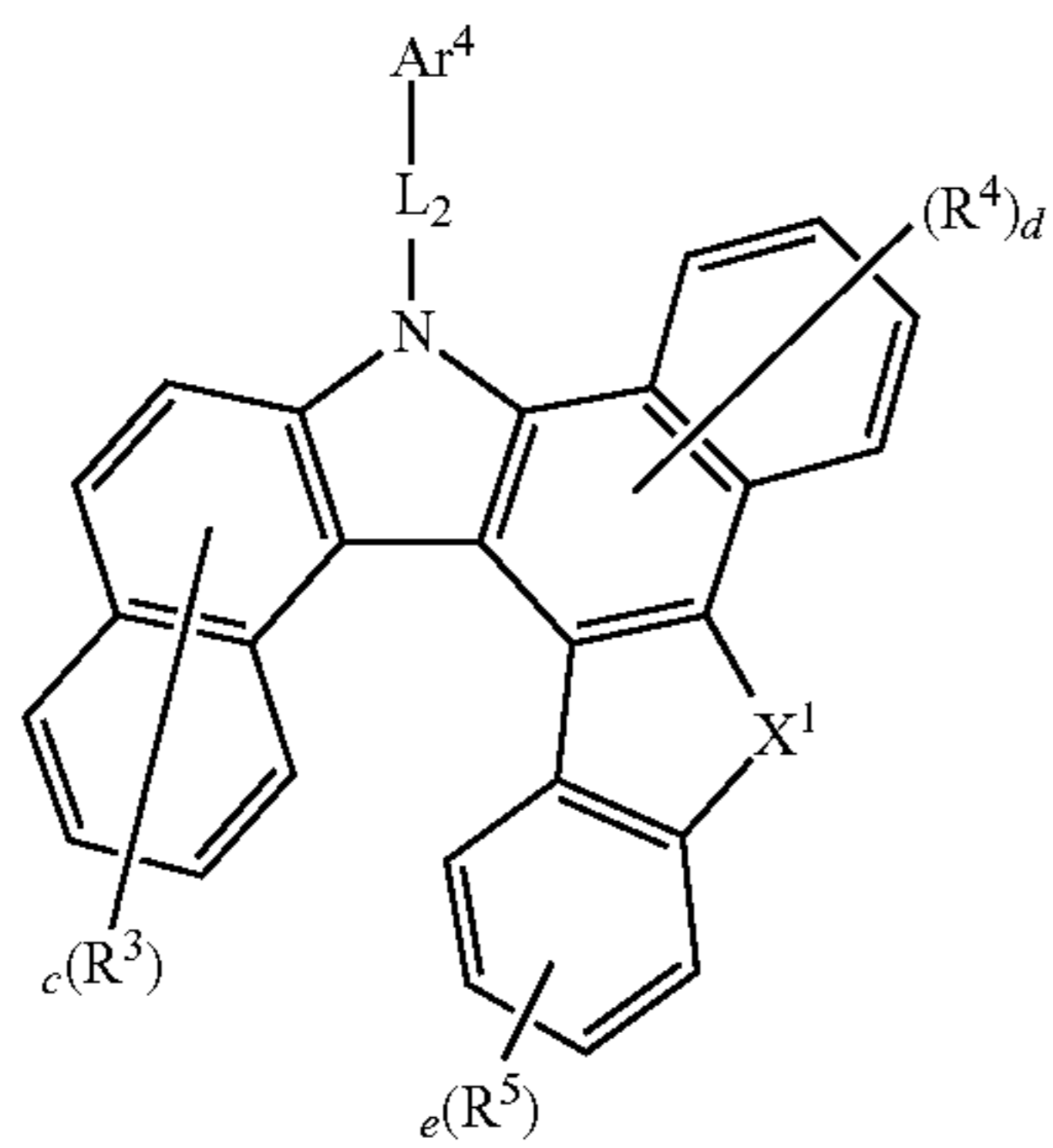
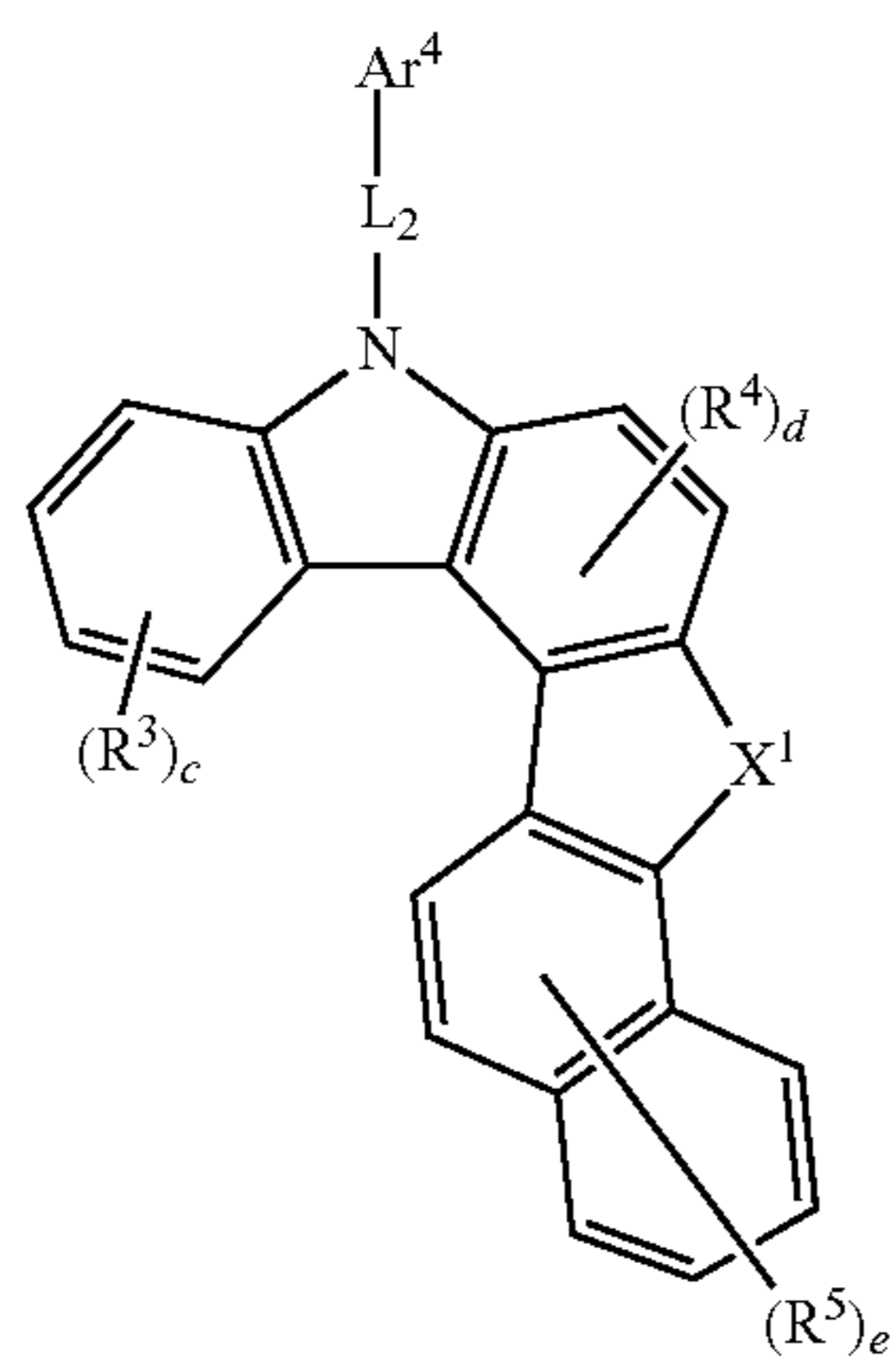
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23

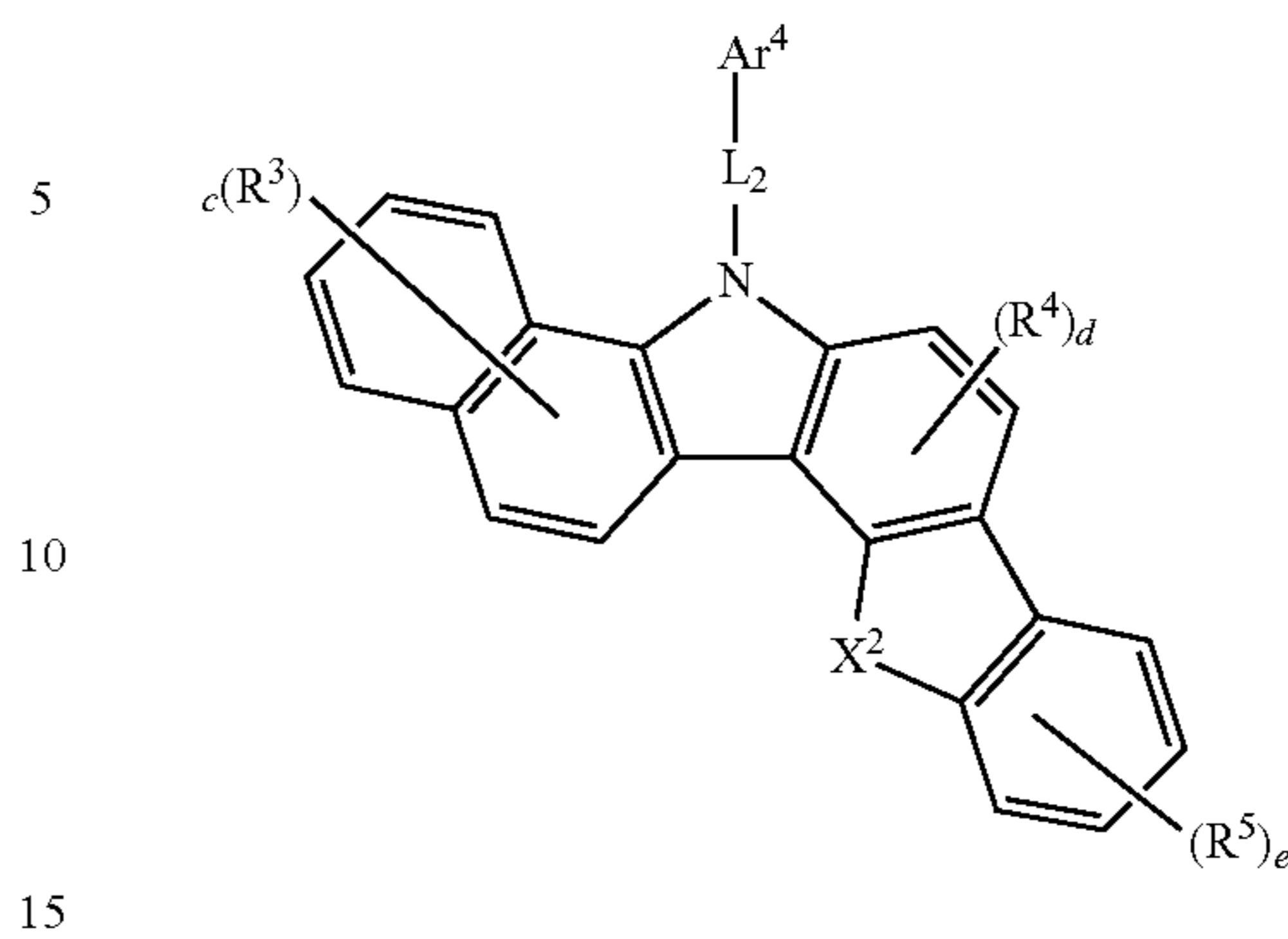
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24

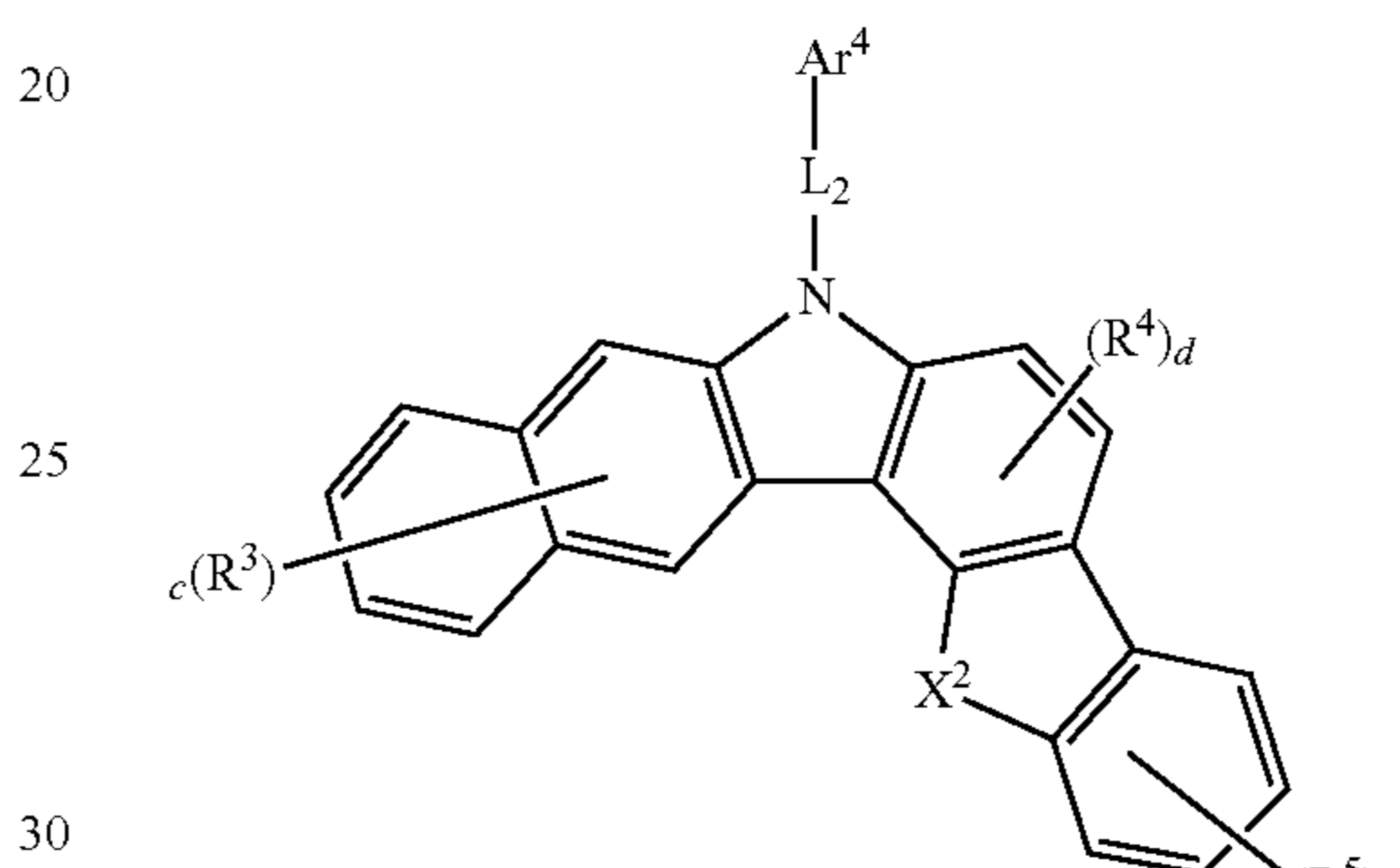
-continued

Formula (35)



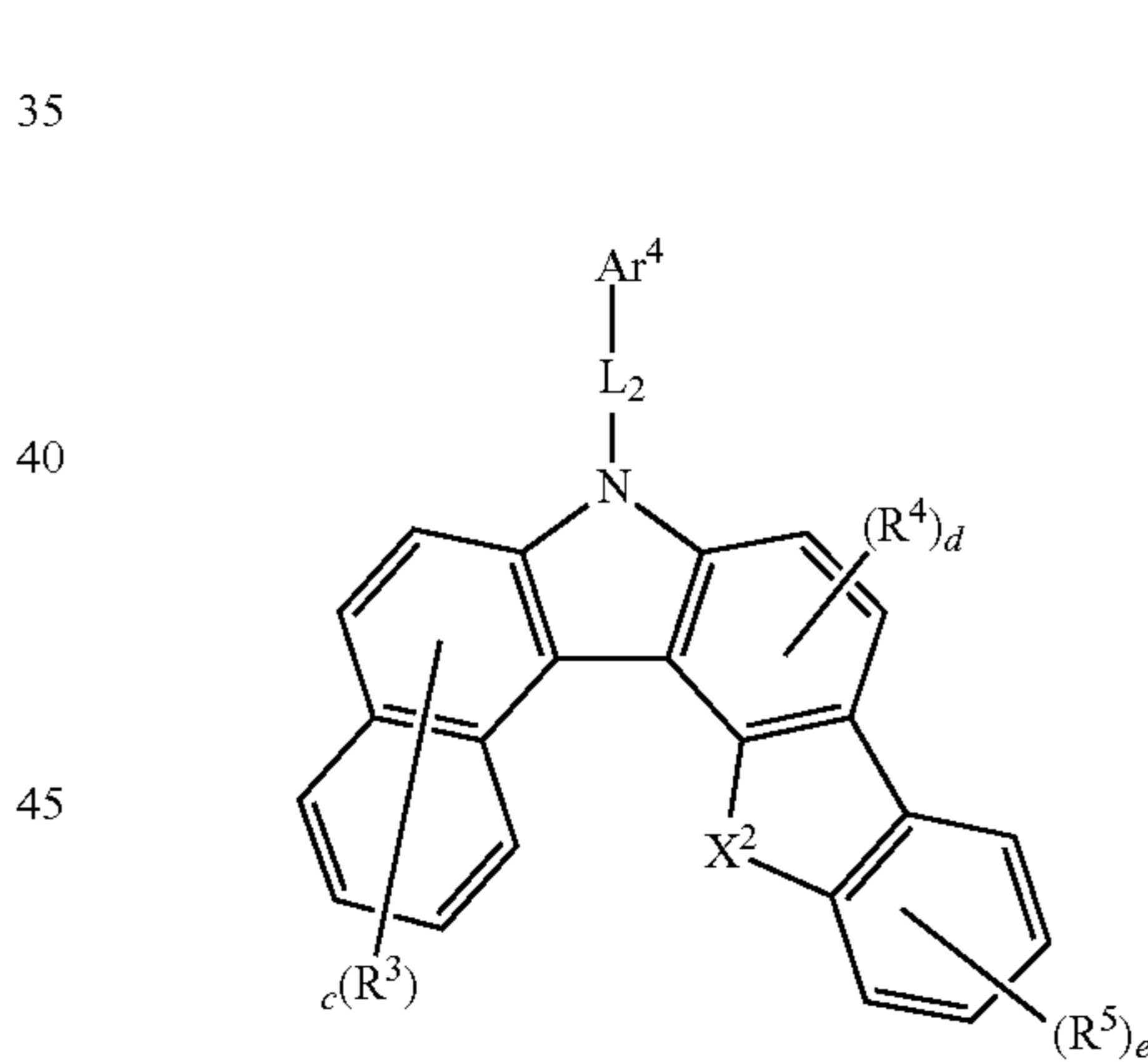
Formula (39)

Formula (36)



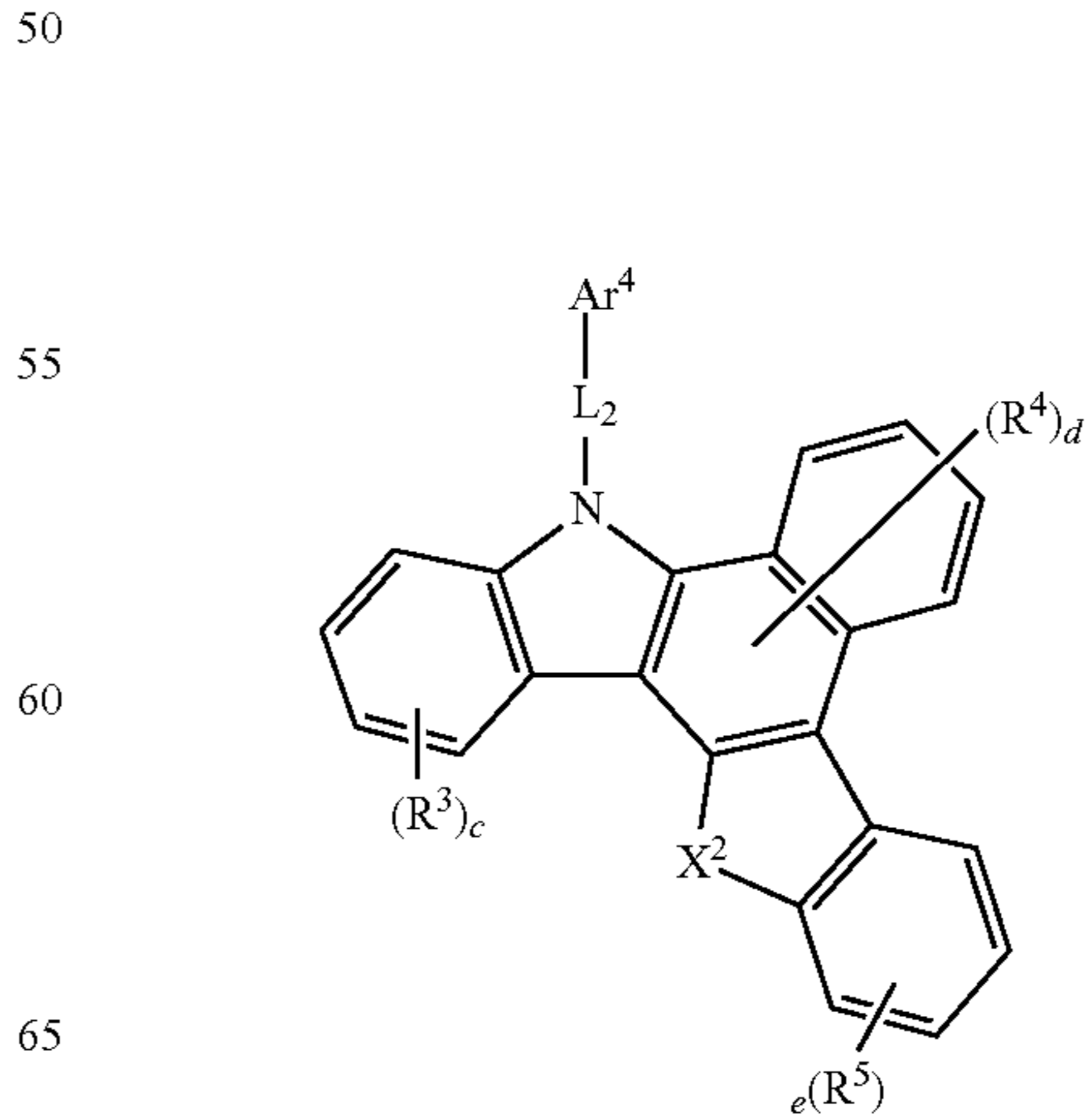
Formula (40)

Formula (37)



Formula (41)

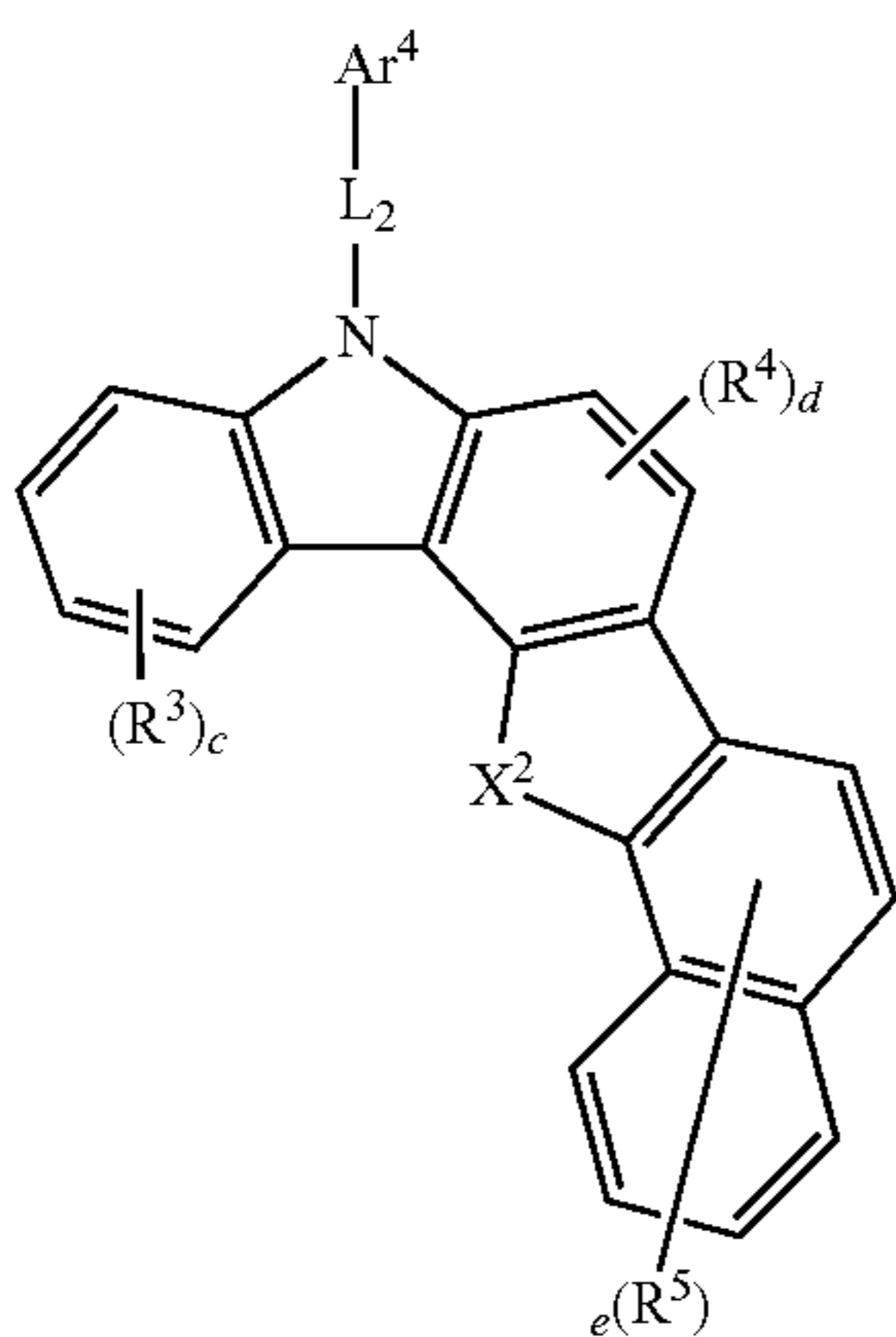
Formula (38)



Formula (42)

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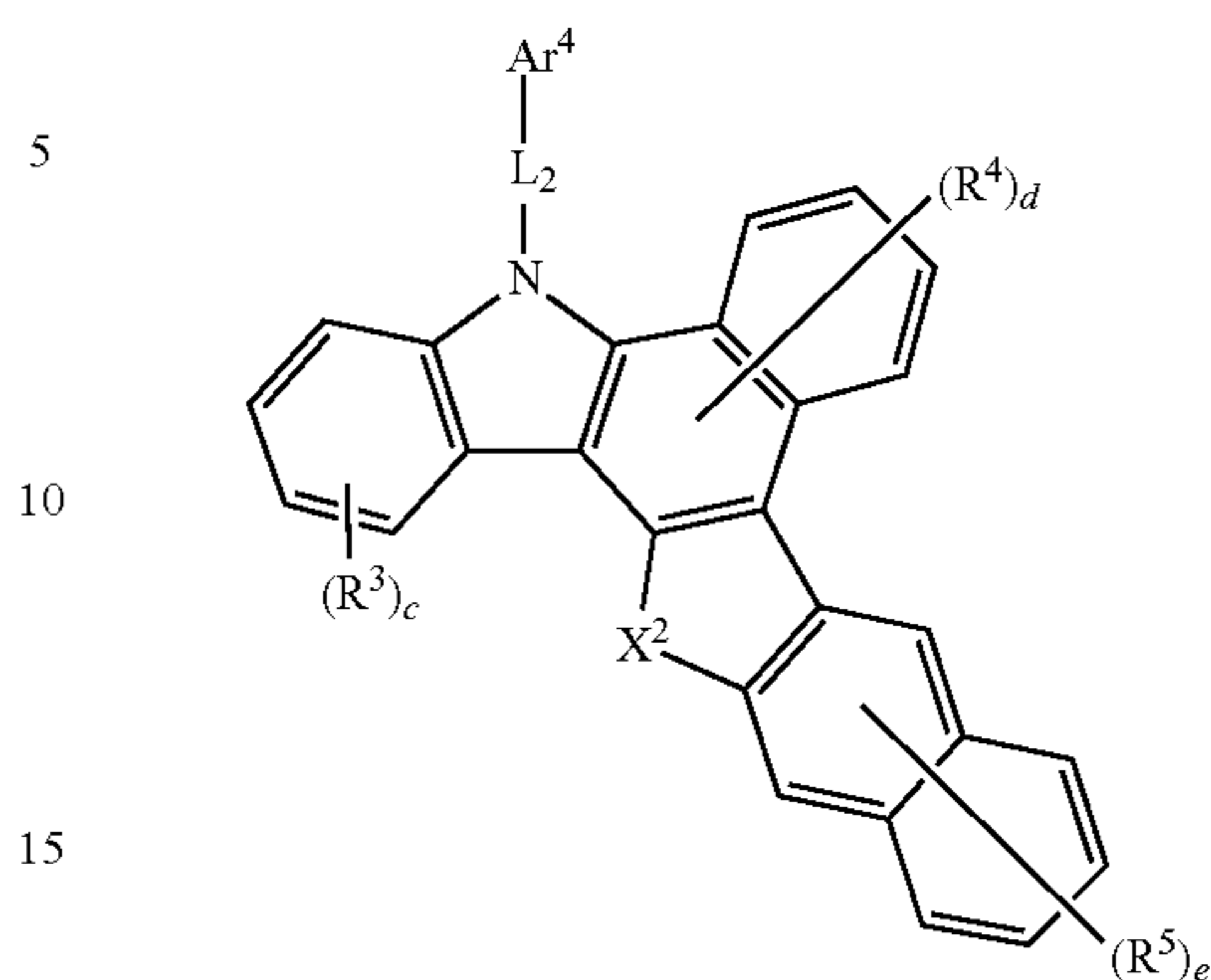
-continued



Formula (43)

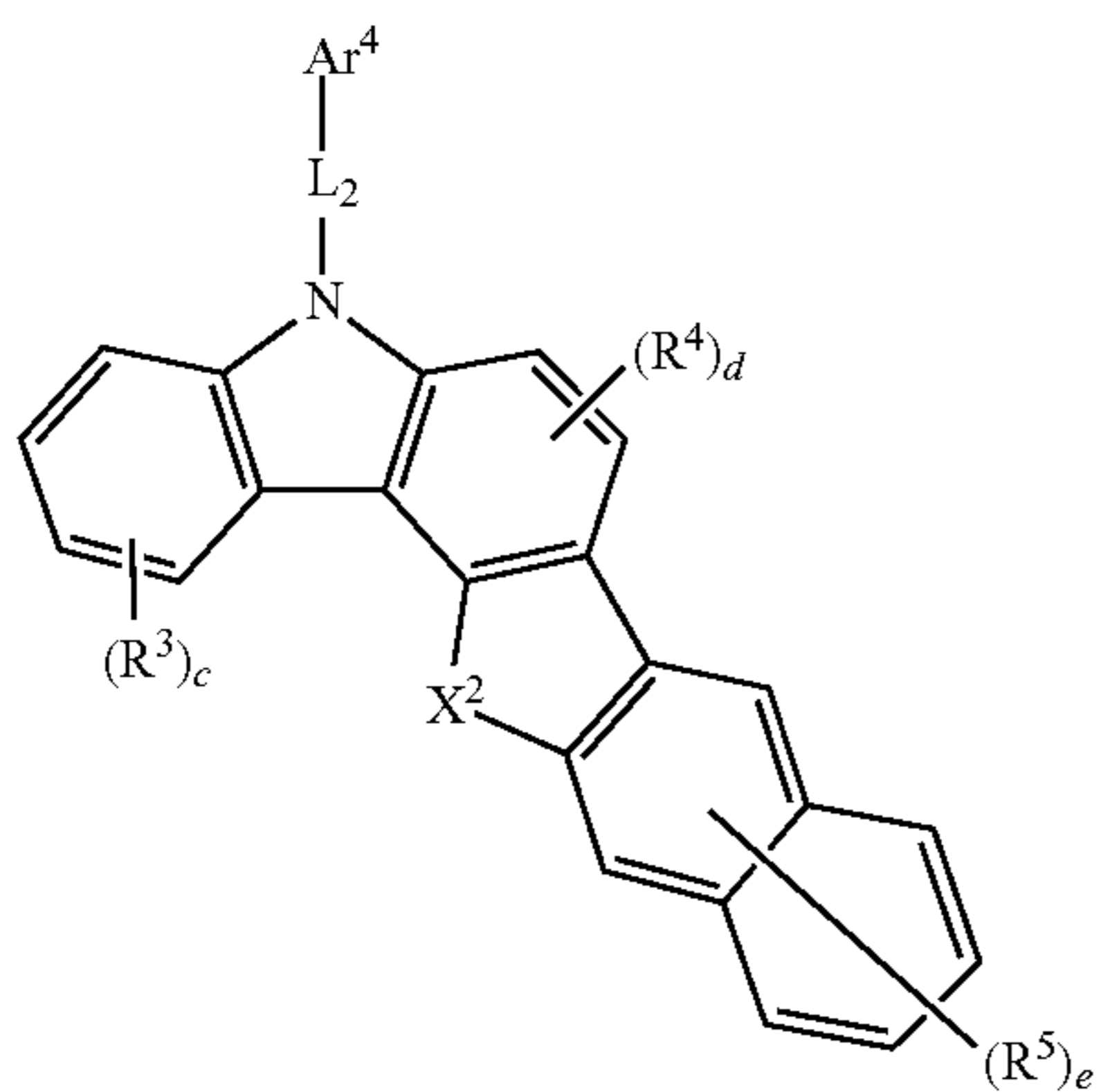
26

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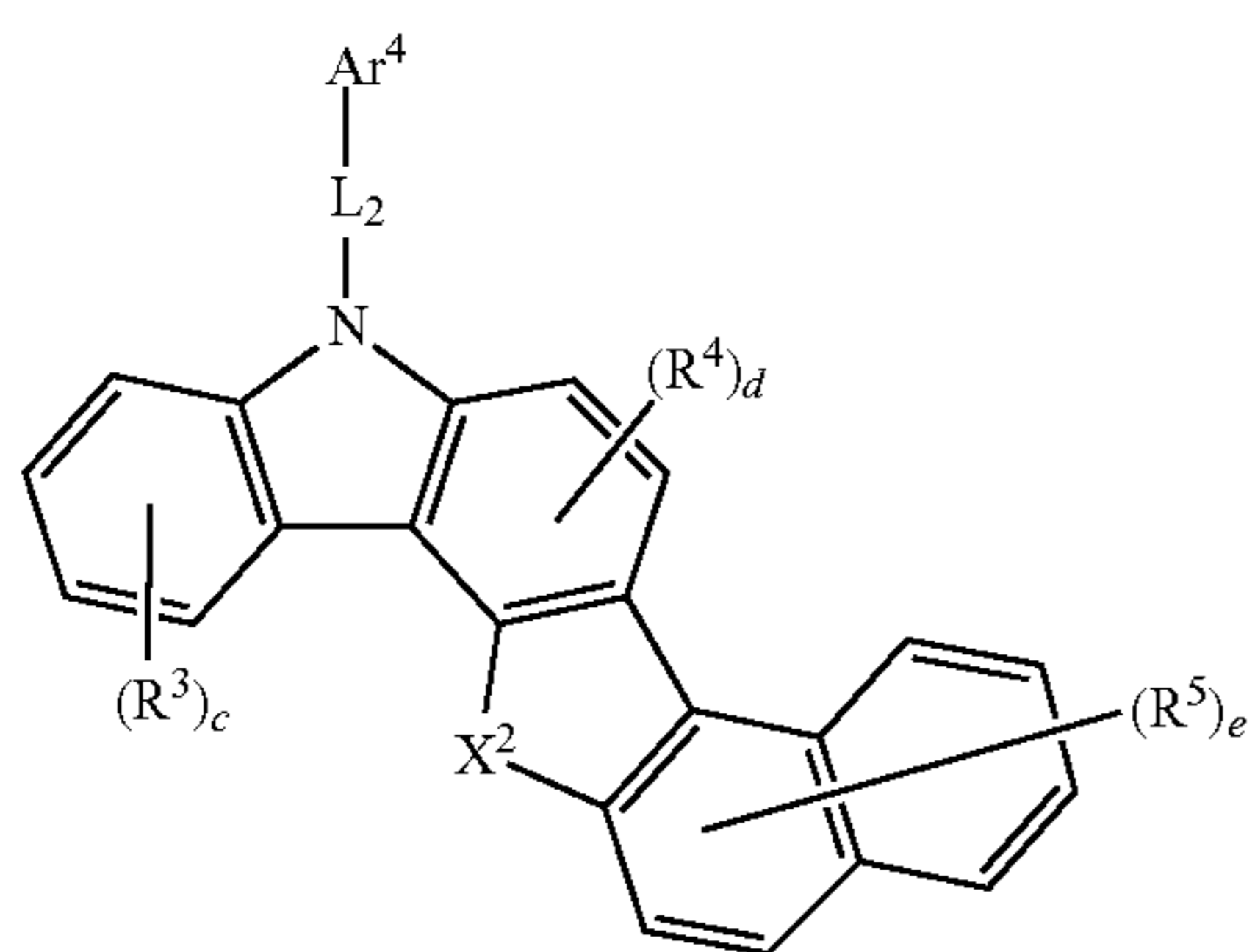
Formula (47)

Formula (44)



Formula (48)

Formula (45)

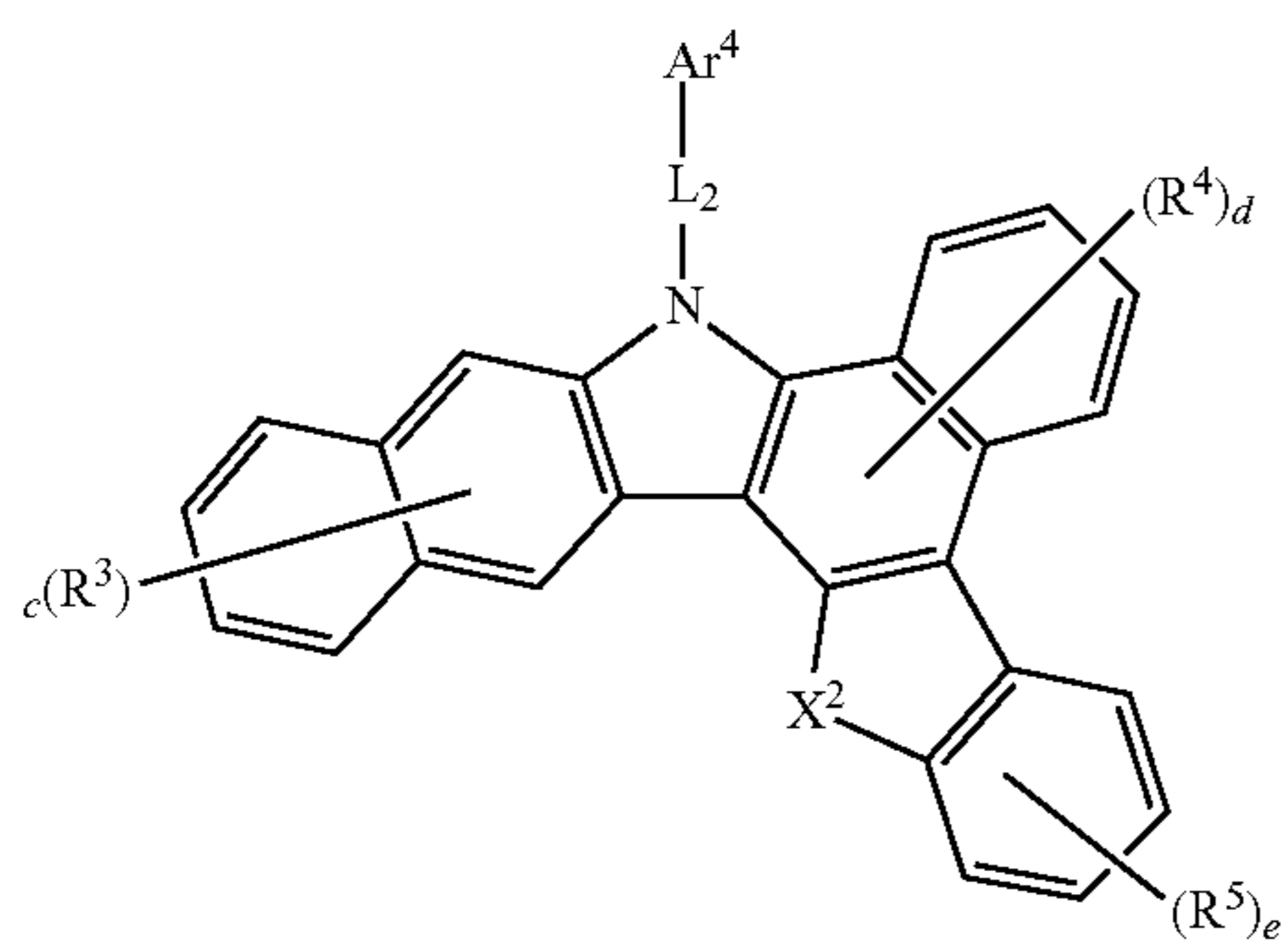


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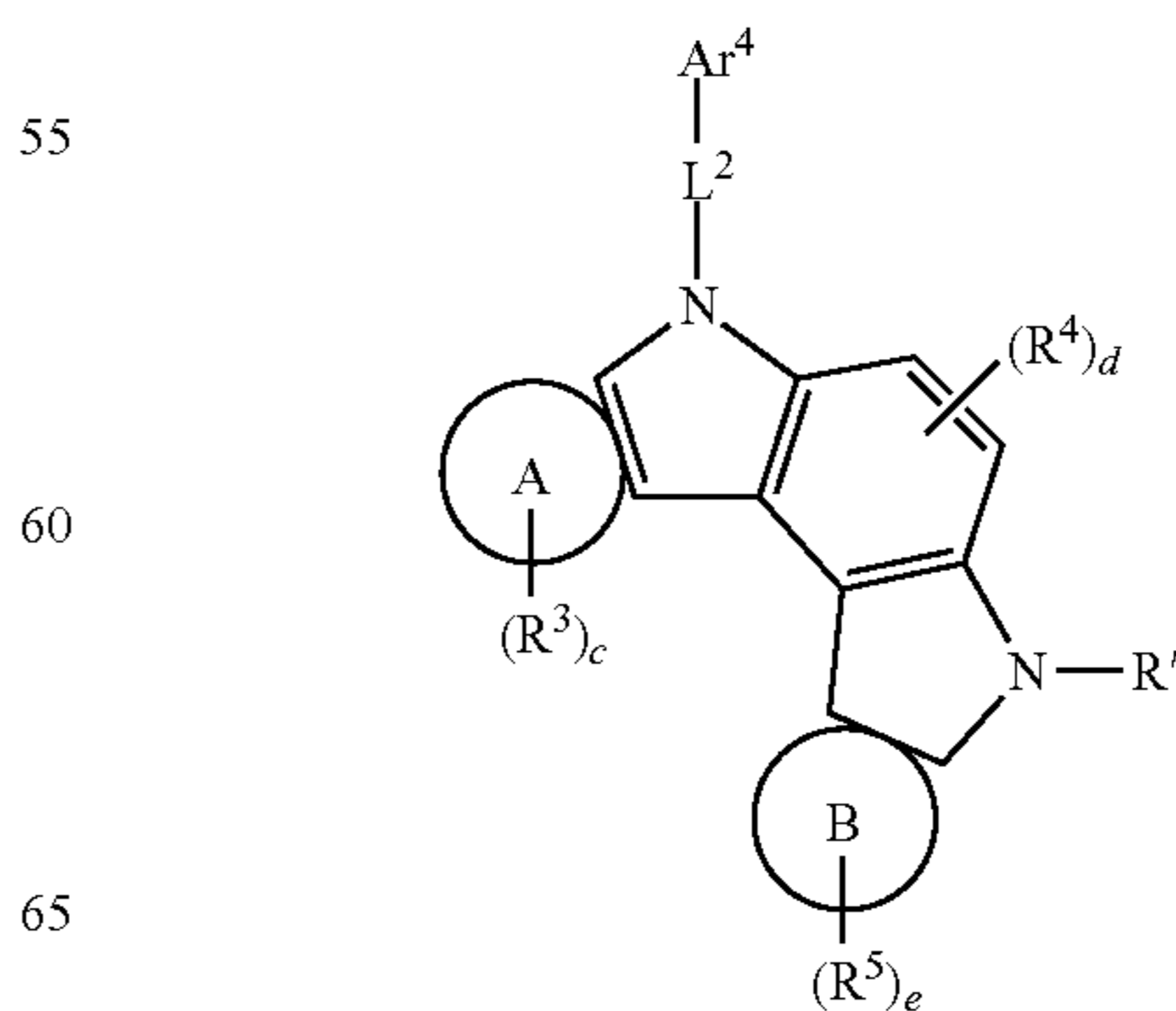
{In Formulas (29) to (48),  
 45 Ar<sup>4</sup>, L<sup>2</sup>, X<sup>1</sup>, X<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, c, d and e are the same as  
 defined in Formula (2).}

In the present invention, the second host compound  
 represented by Formula (2) comprises any of compounds  
 50 represented by the following Formulas (49) to (55).

Formula (46)



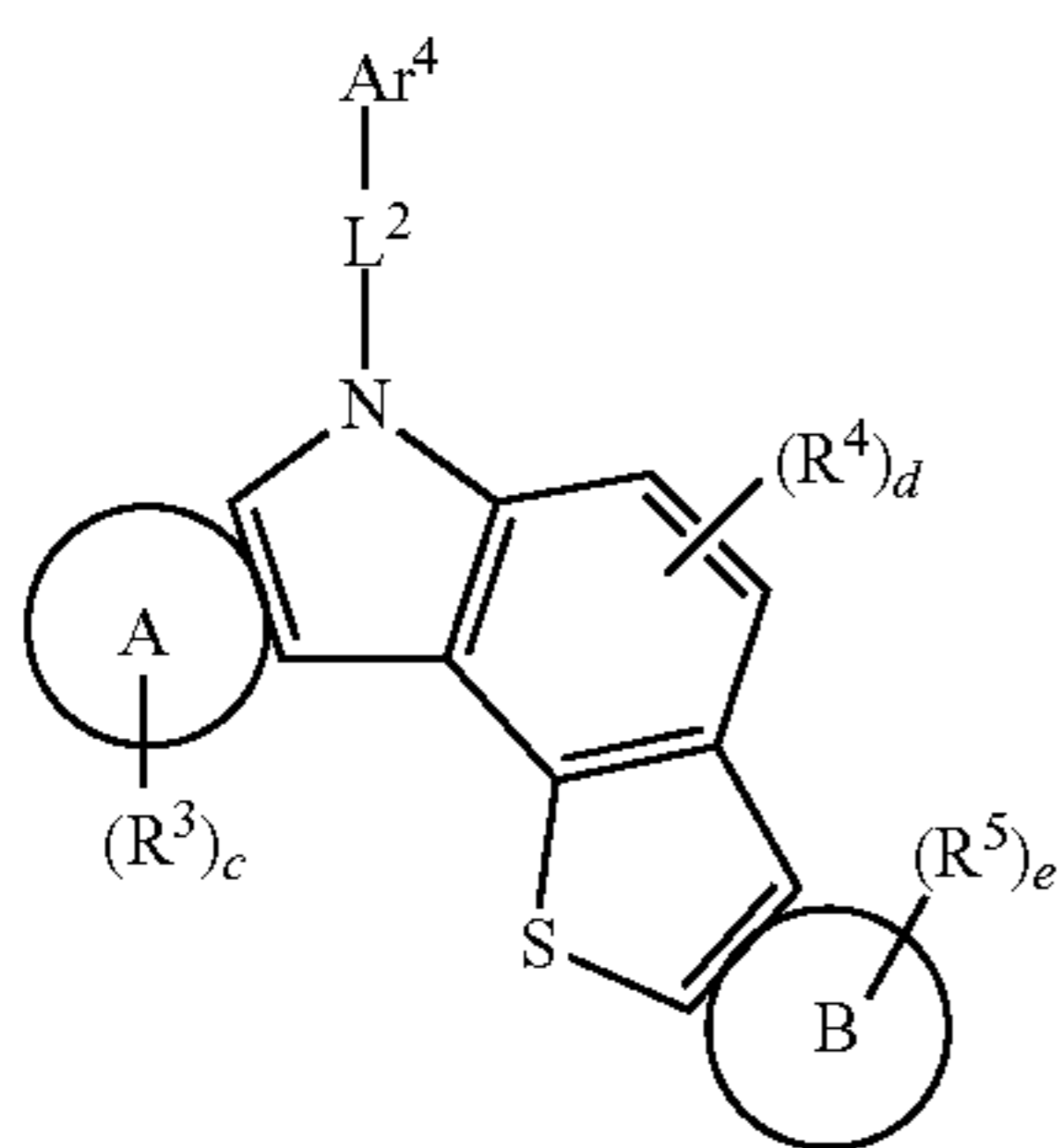
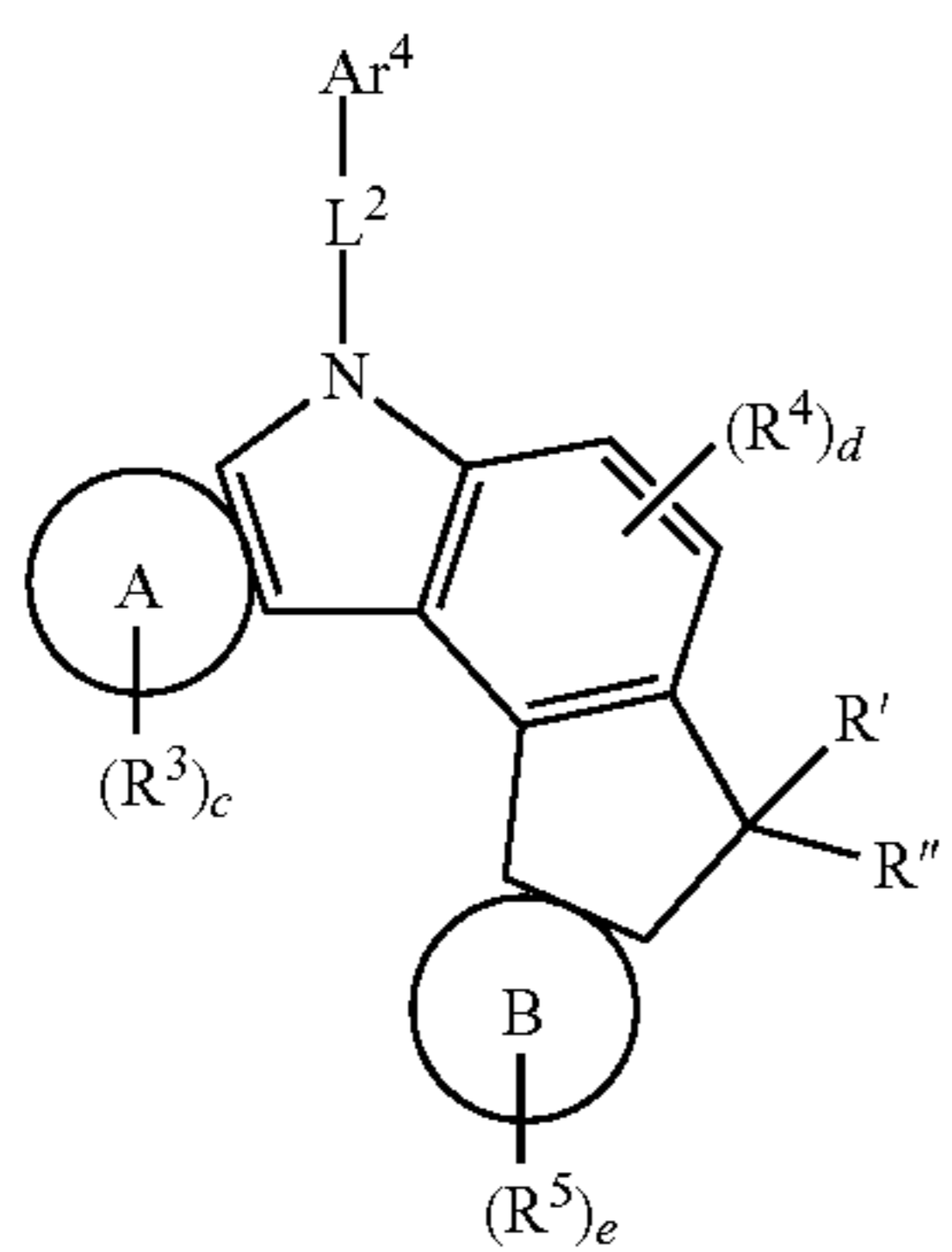
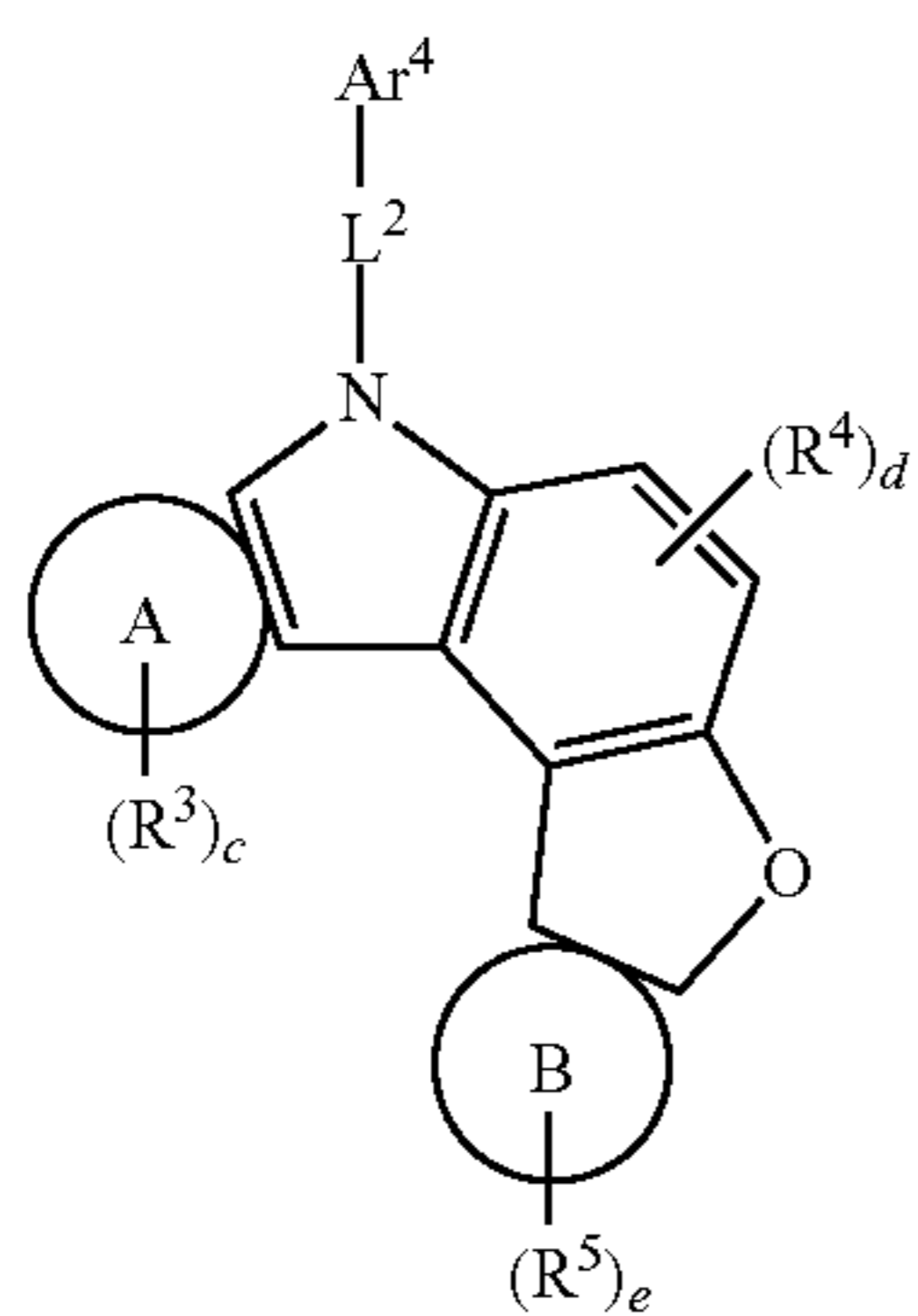
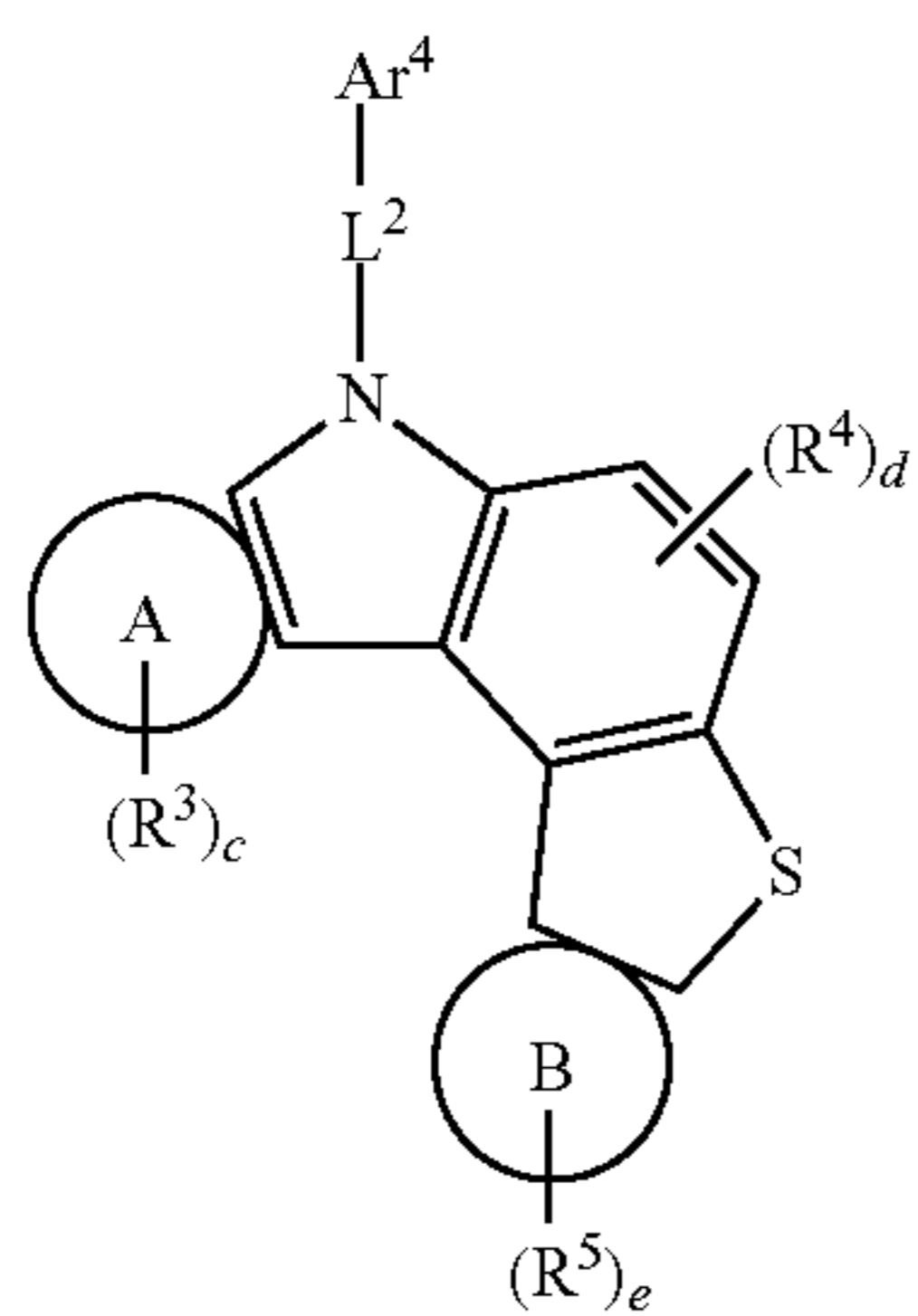
Formula (49)





27

-continued



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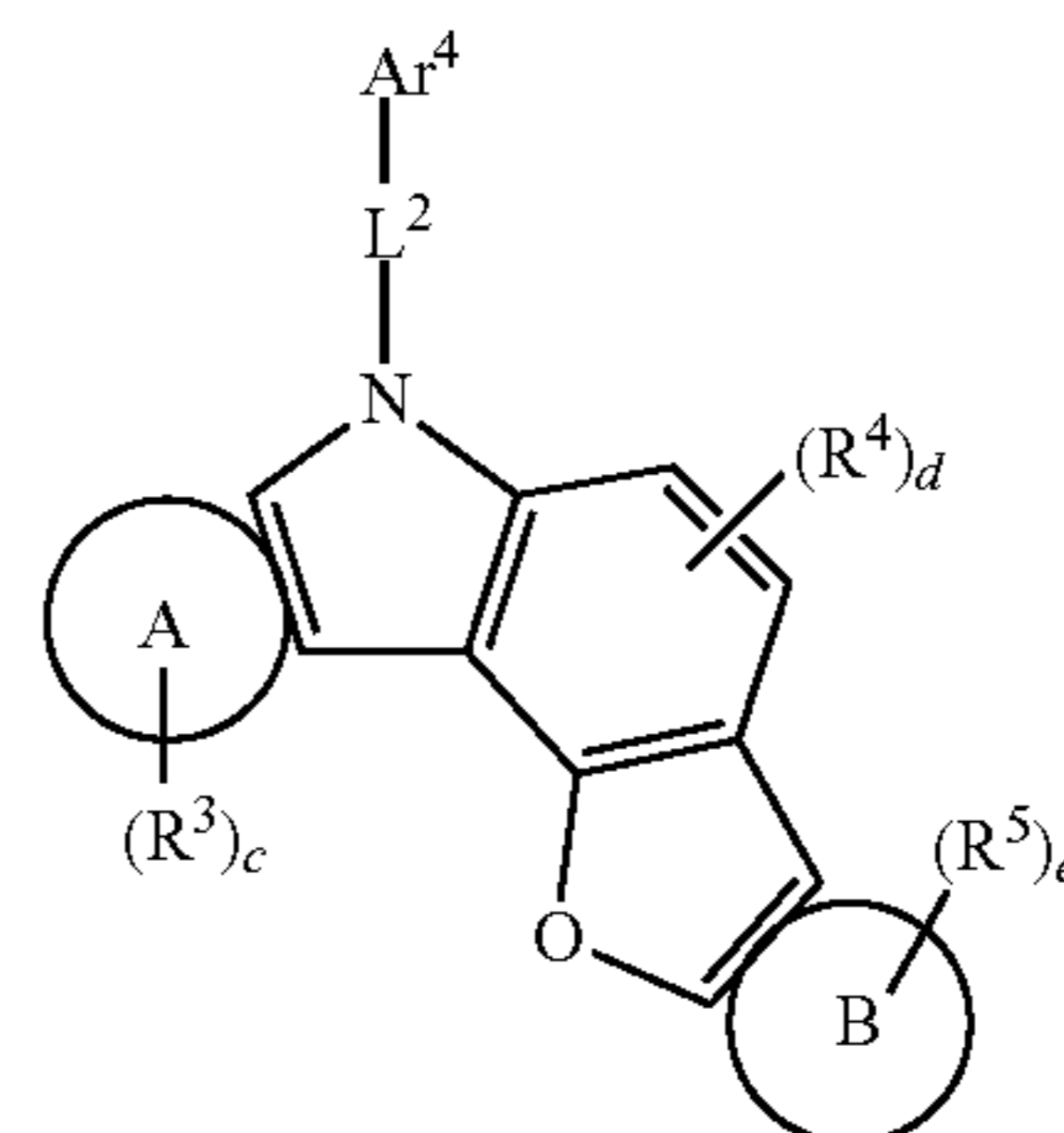
-continued

Formula (50)

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Formula (54)

Formula (51) 20

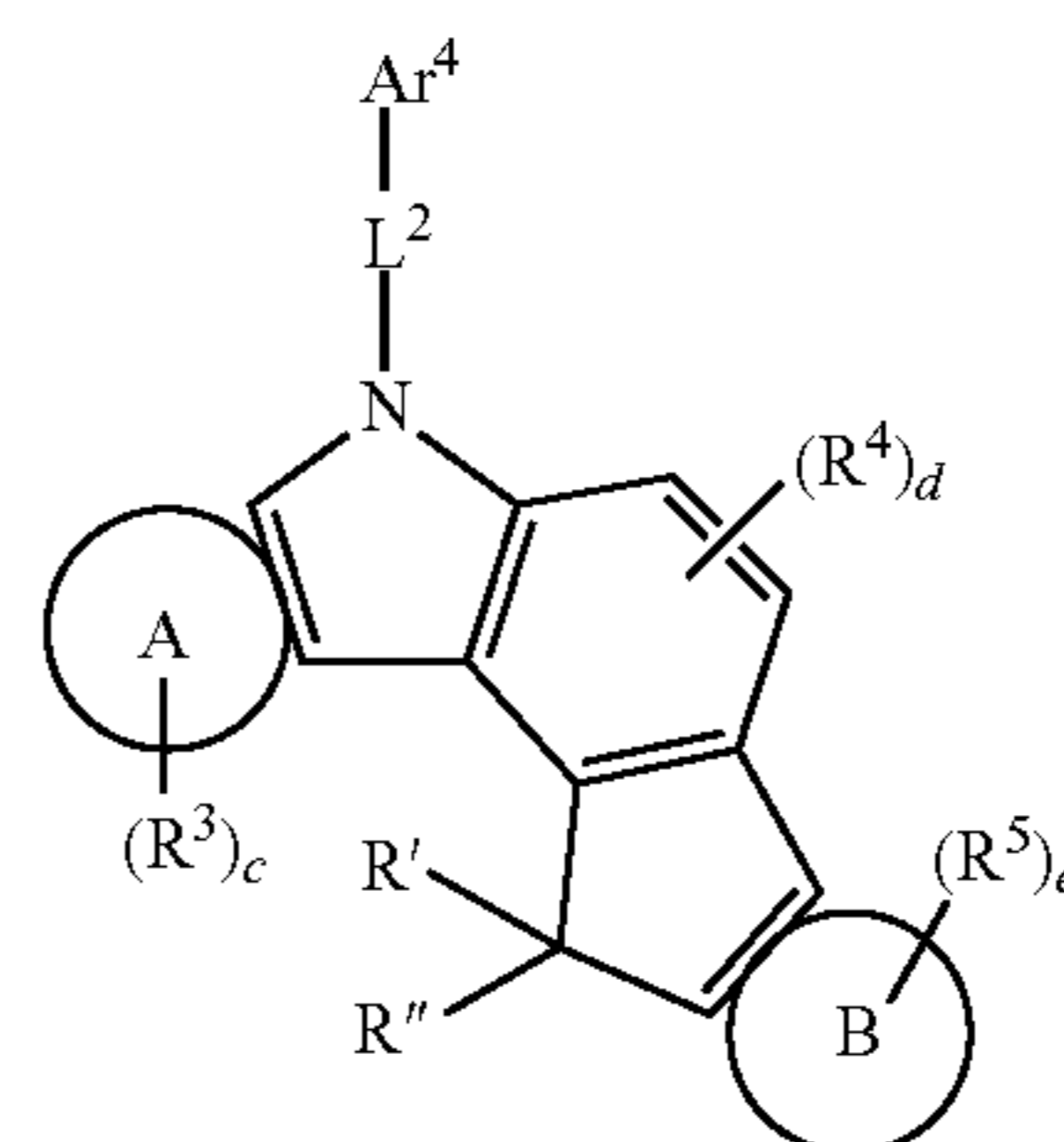
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Formula (52)

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Formula (55)

{In Formulas (49) to (55),  
R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, Ar<sup>4</sup>, L<sup>2</sup>, c, d, e, A, B, R' and R'' are the same  
as defined above.}

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As a specific example of the present invention, the first  
host compound represented by Formula (1) comprises the  
following Compounds 1-1' to 1-82'.

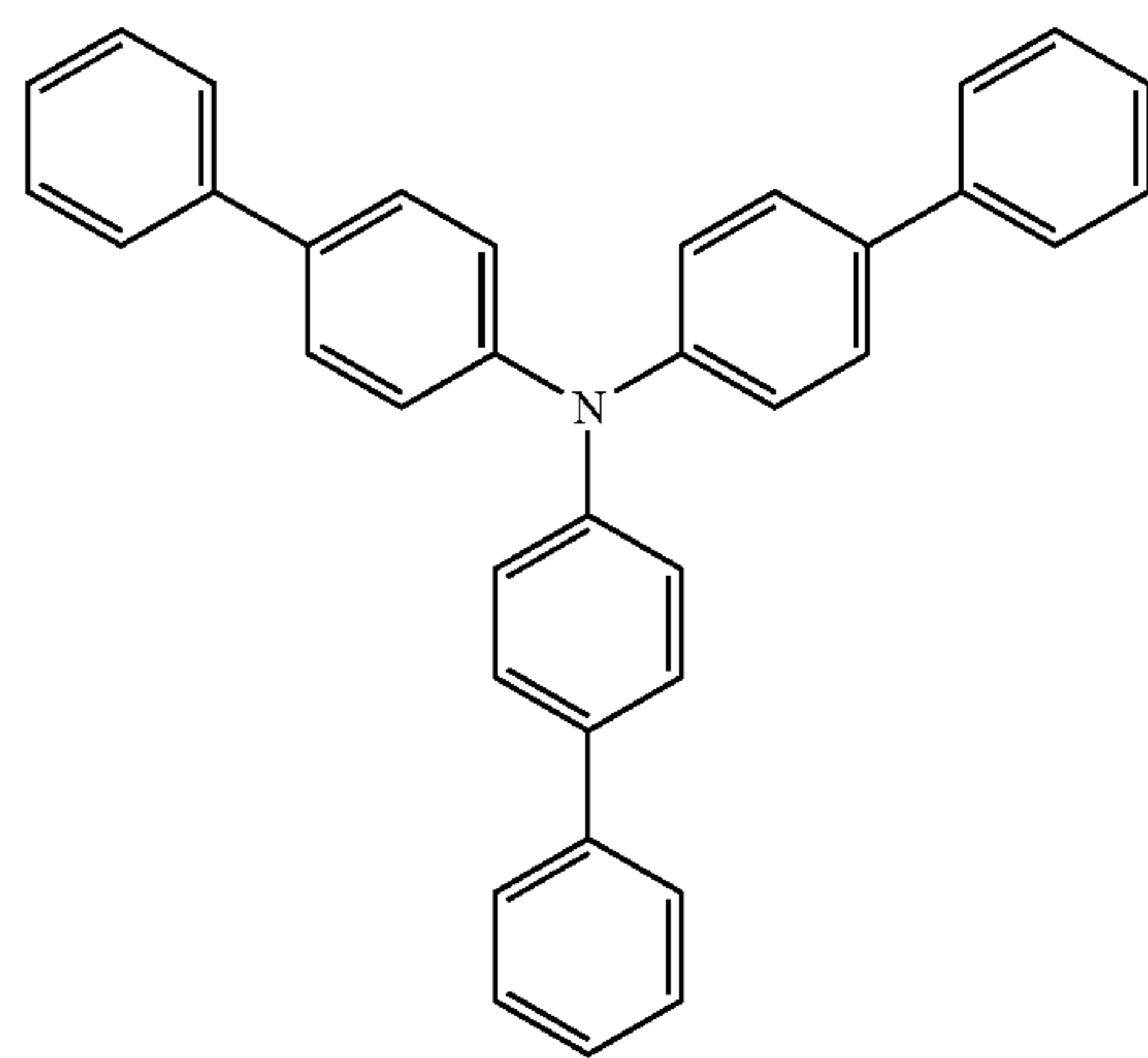
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Formula (53)

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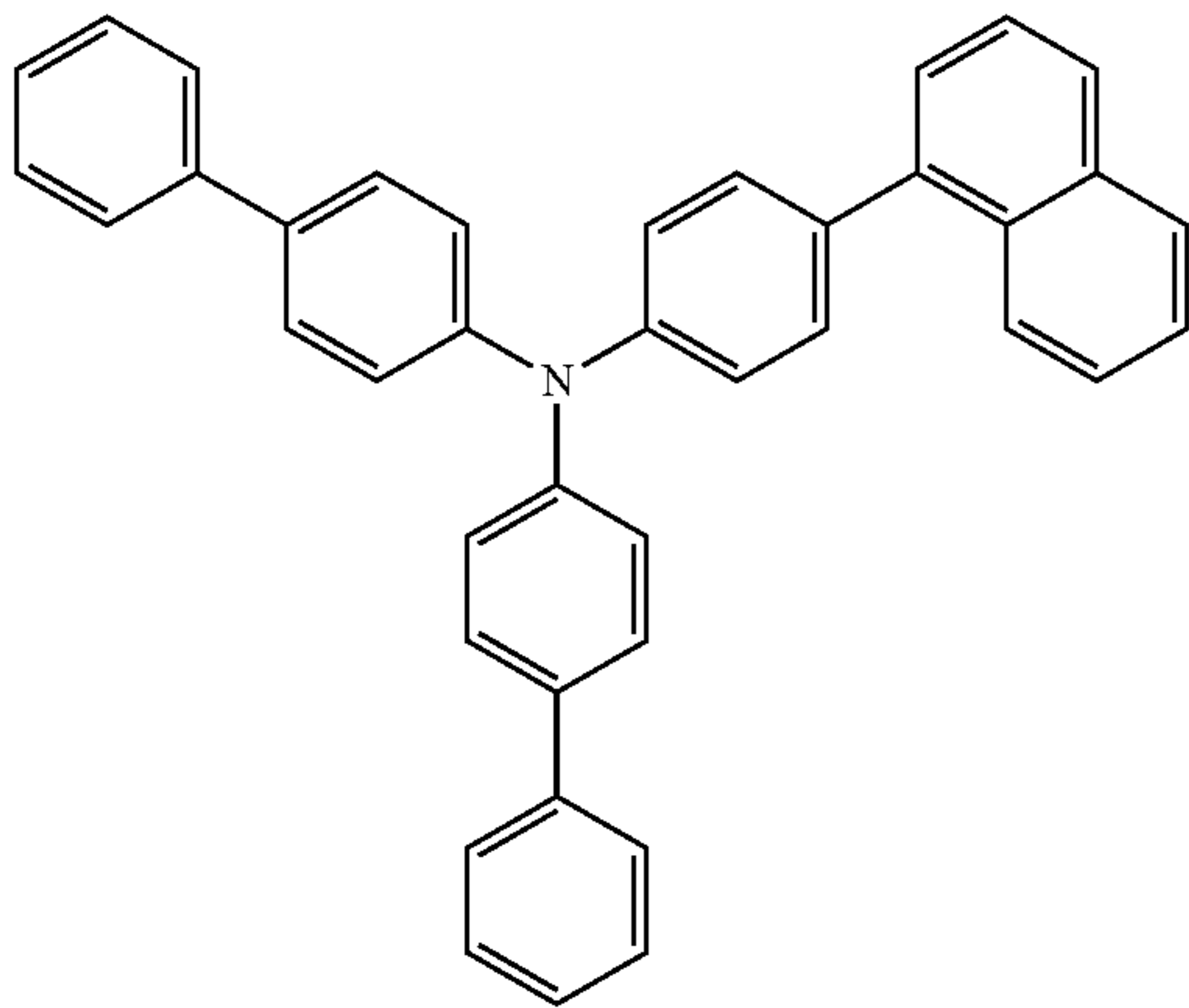
65



1-1'

29

-continued



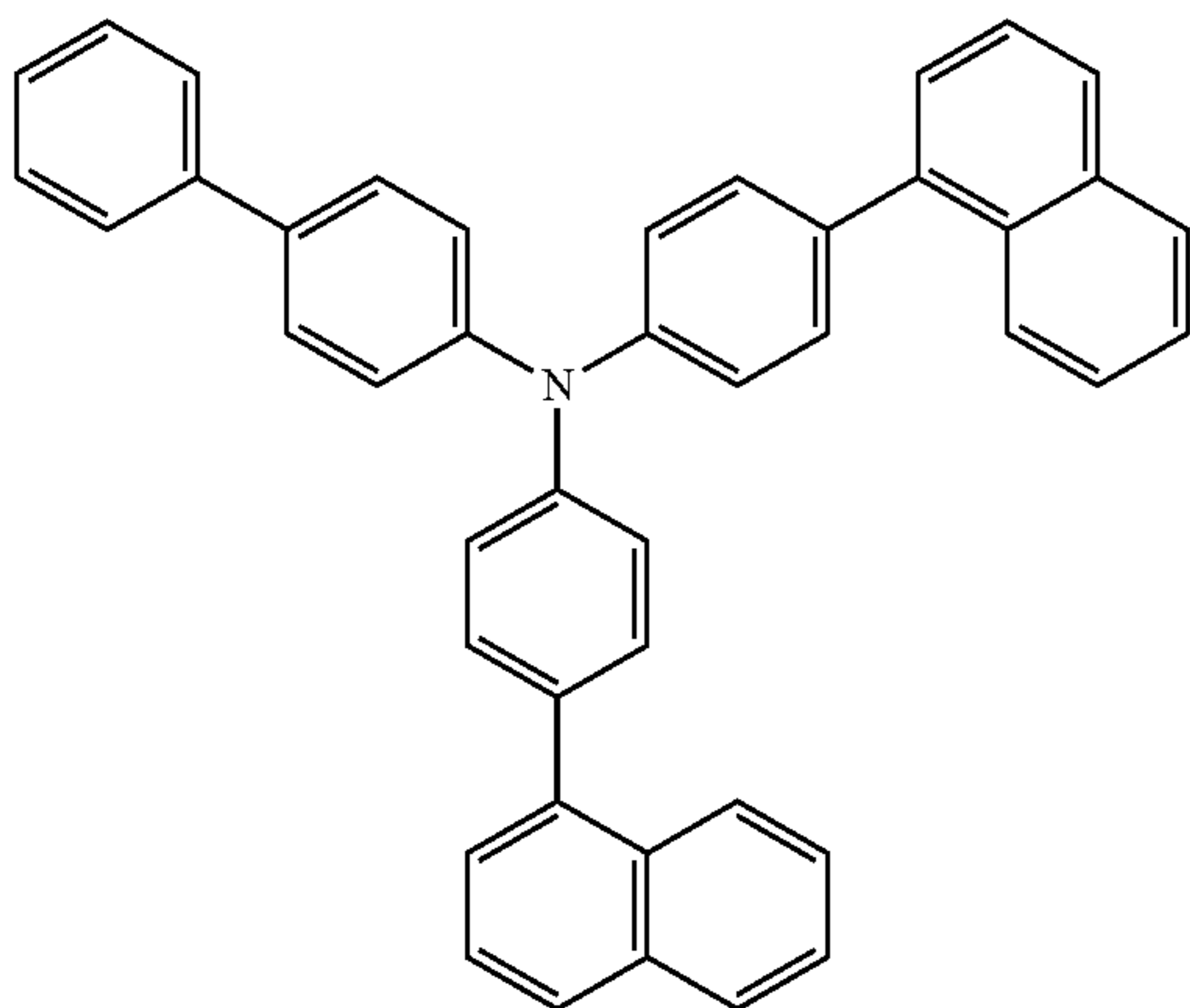
1-2'

5

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1-3'

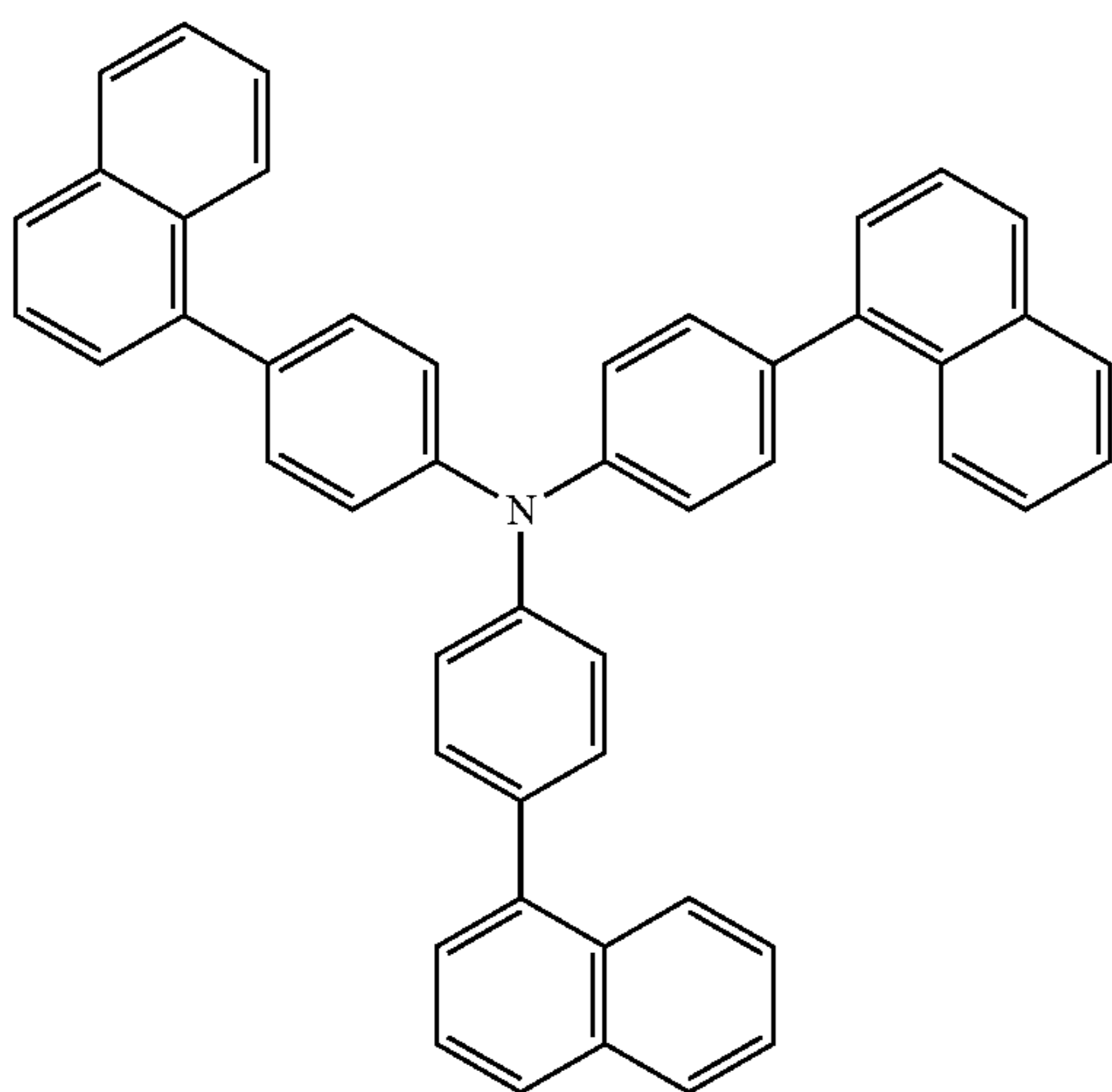
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1-4'

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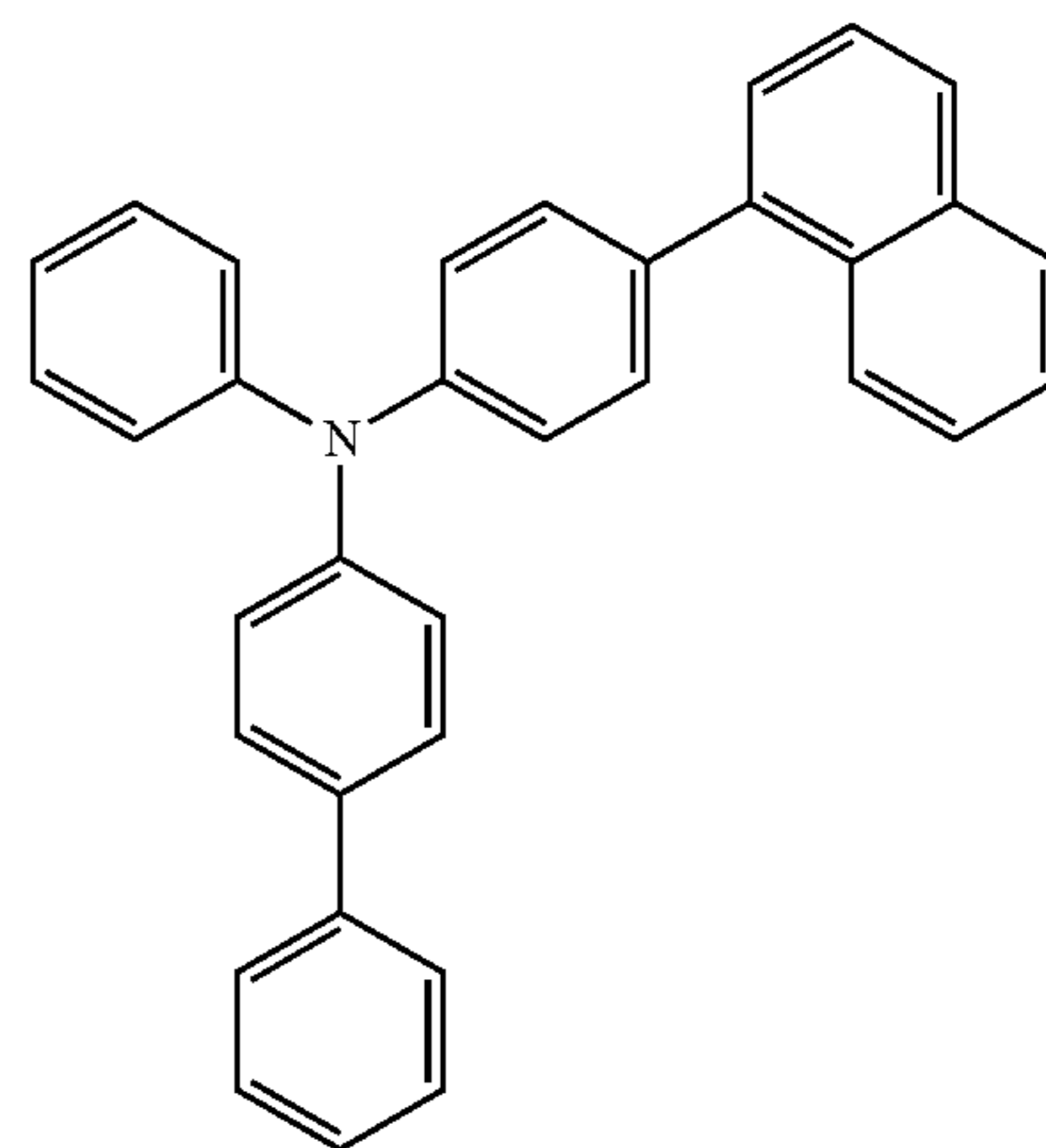
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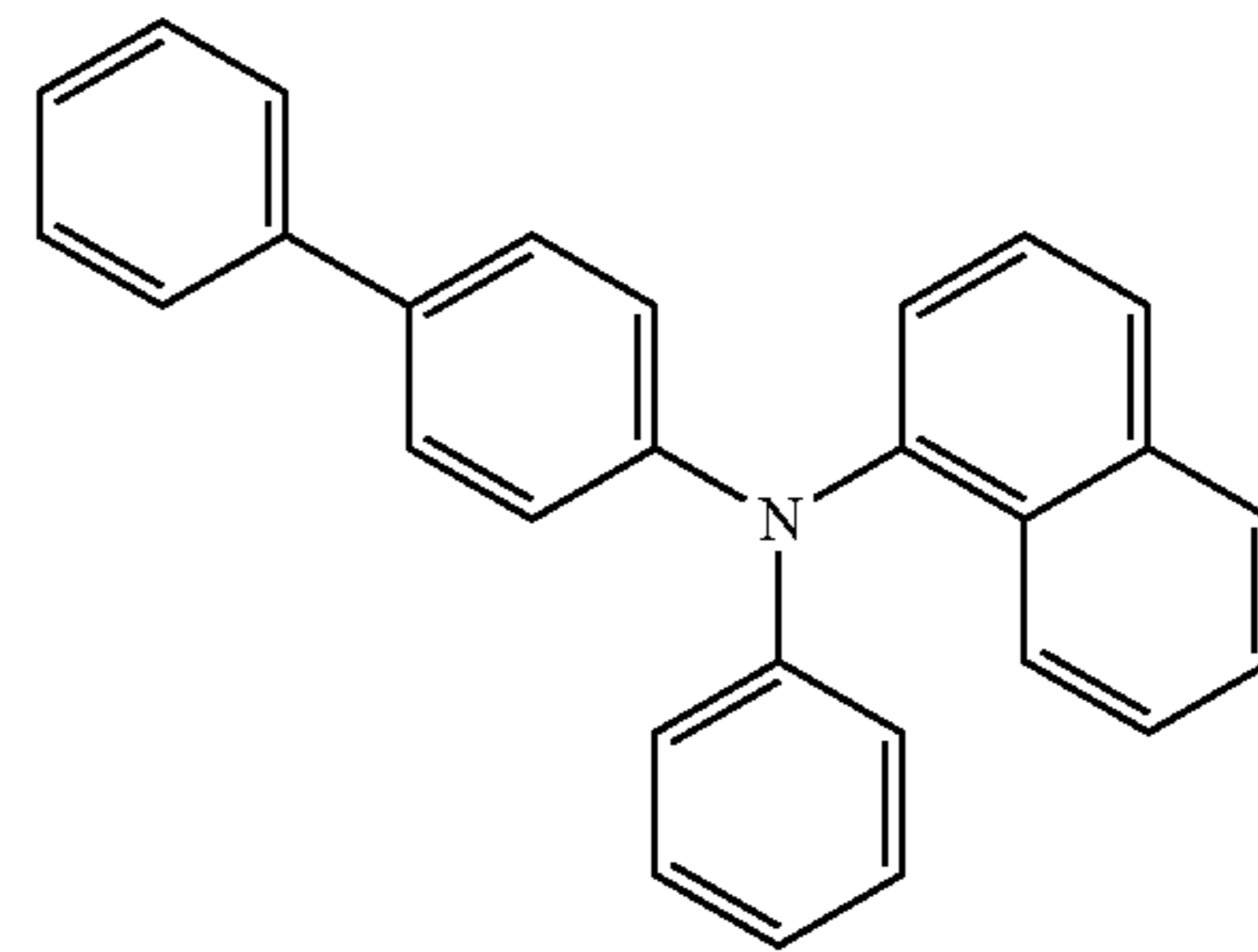
65

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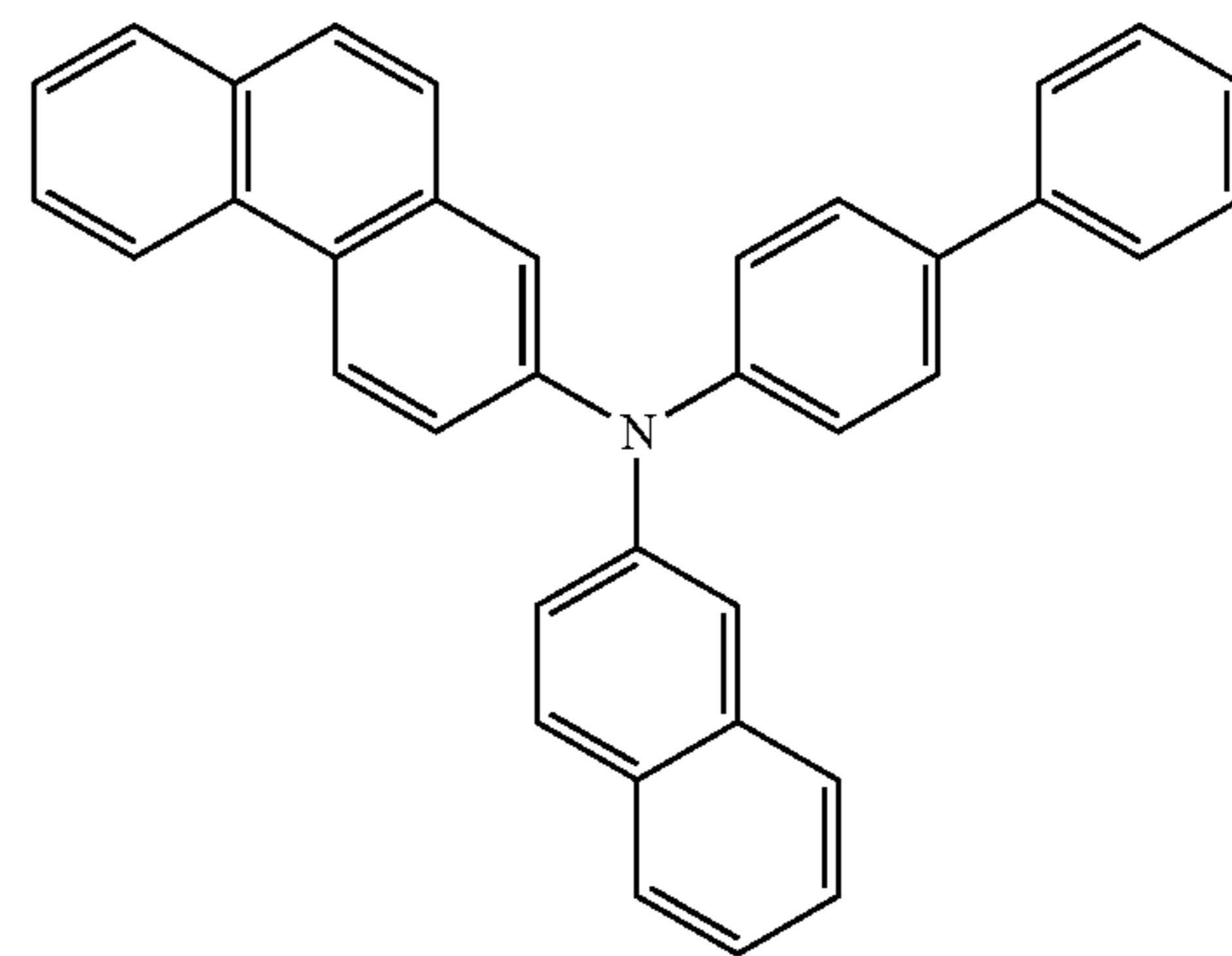
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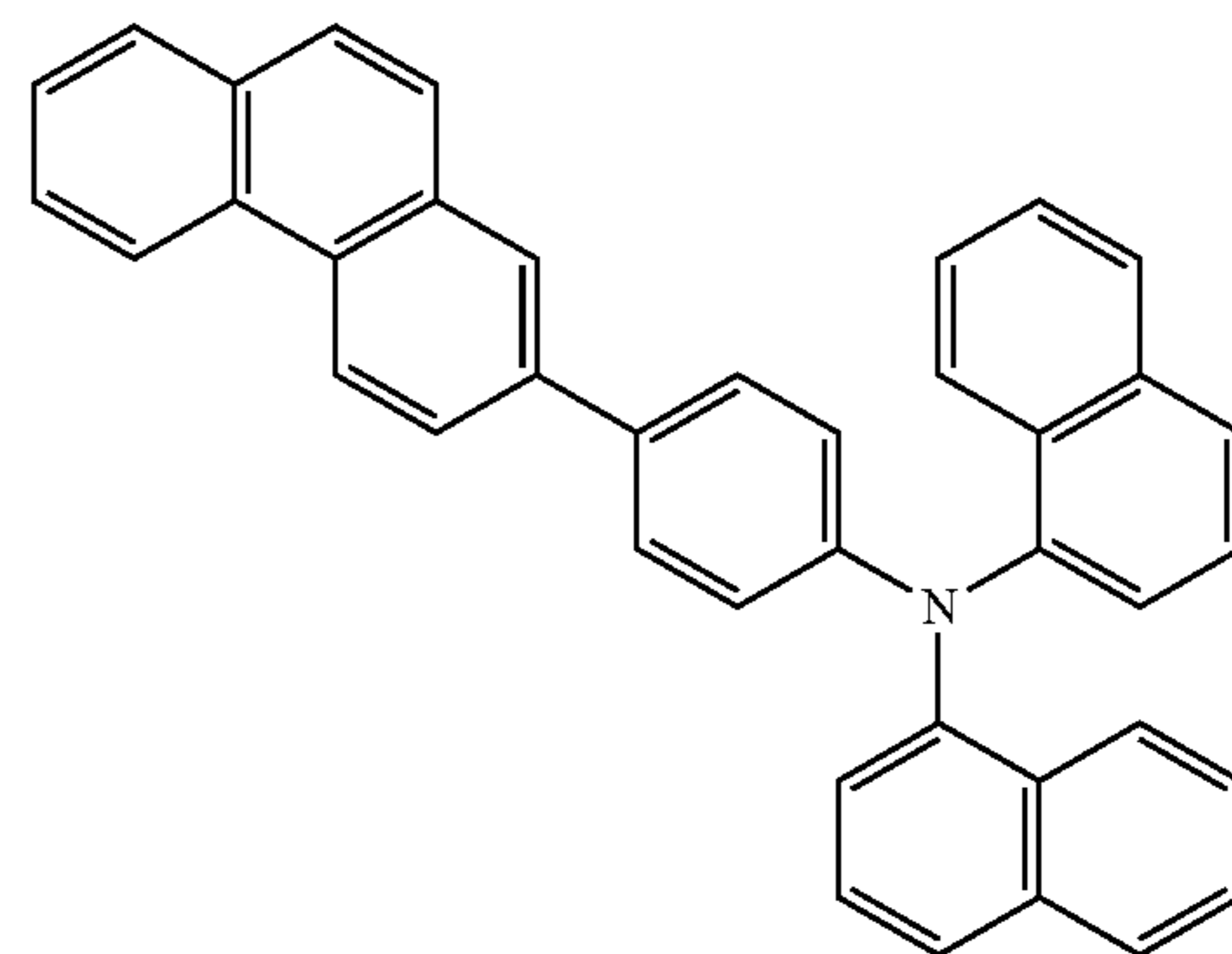
1-5'



1-6'



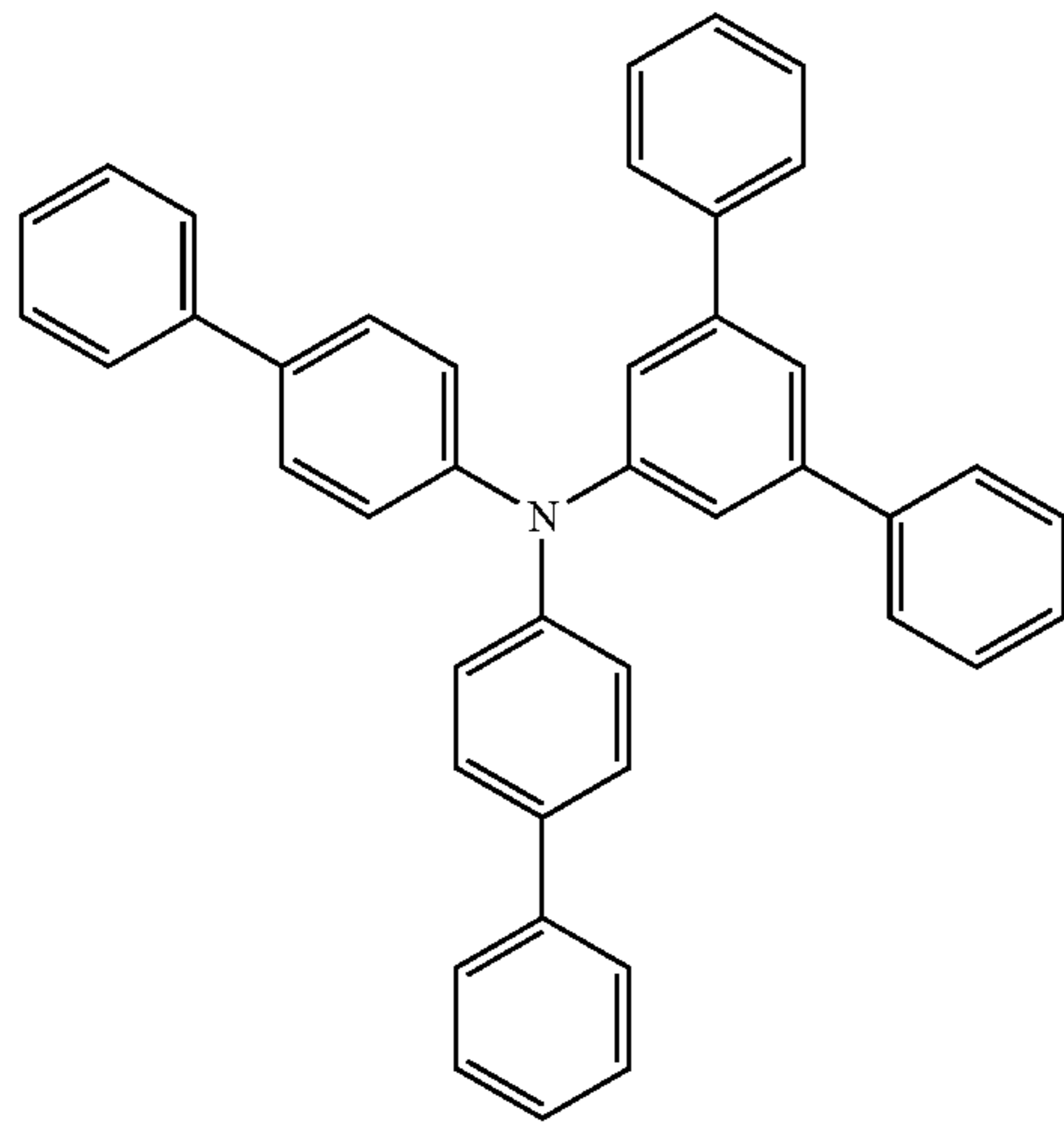
1-7'



1-8'

31

-continued



1-9'

5

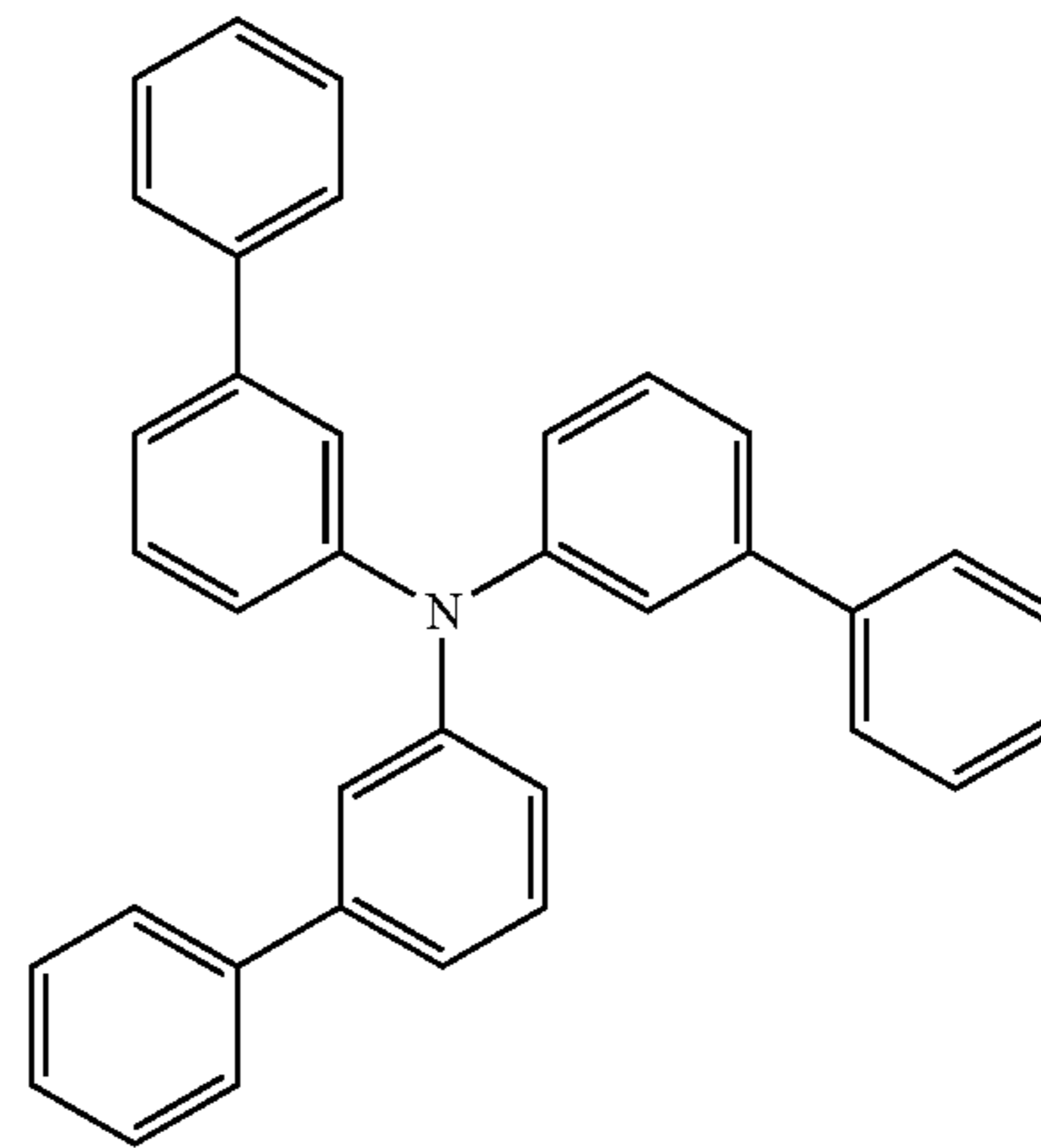
10

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32

-continued



1-12'

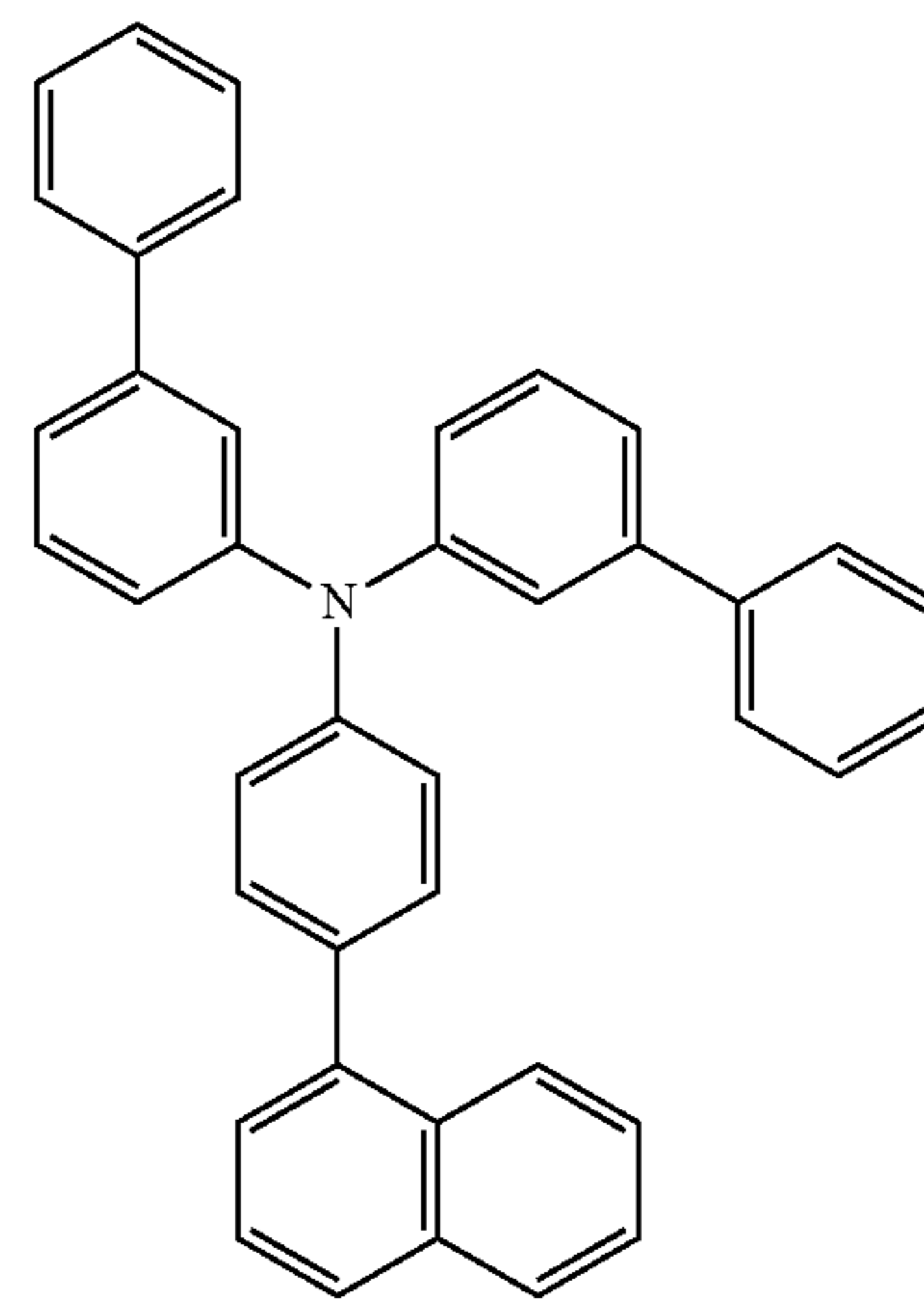
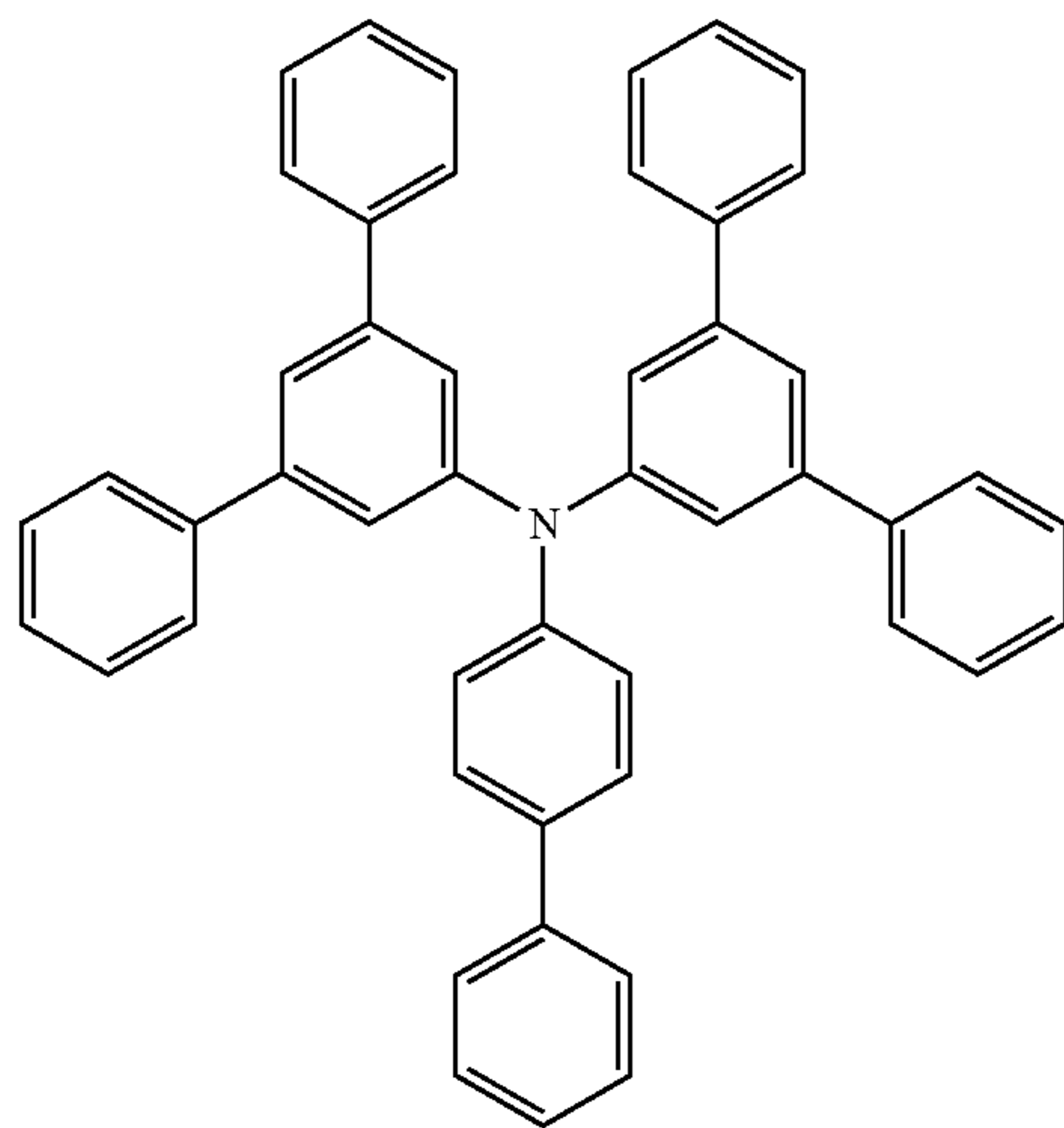
1-10' 25

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1-13'

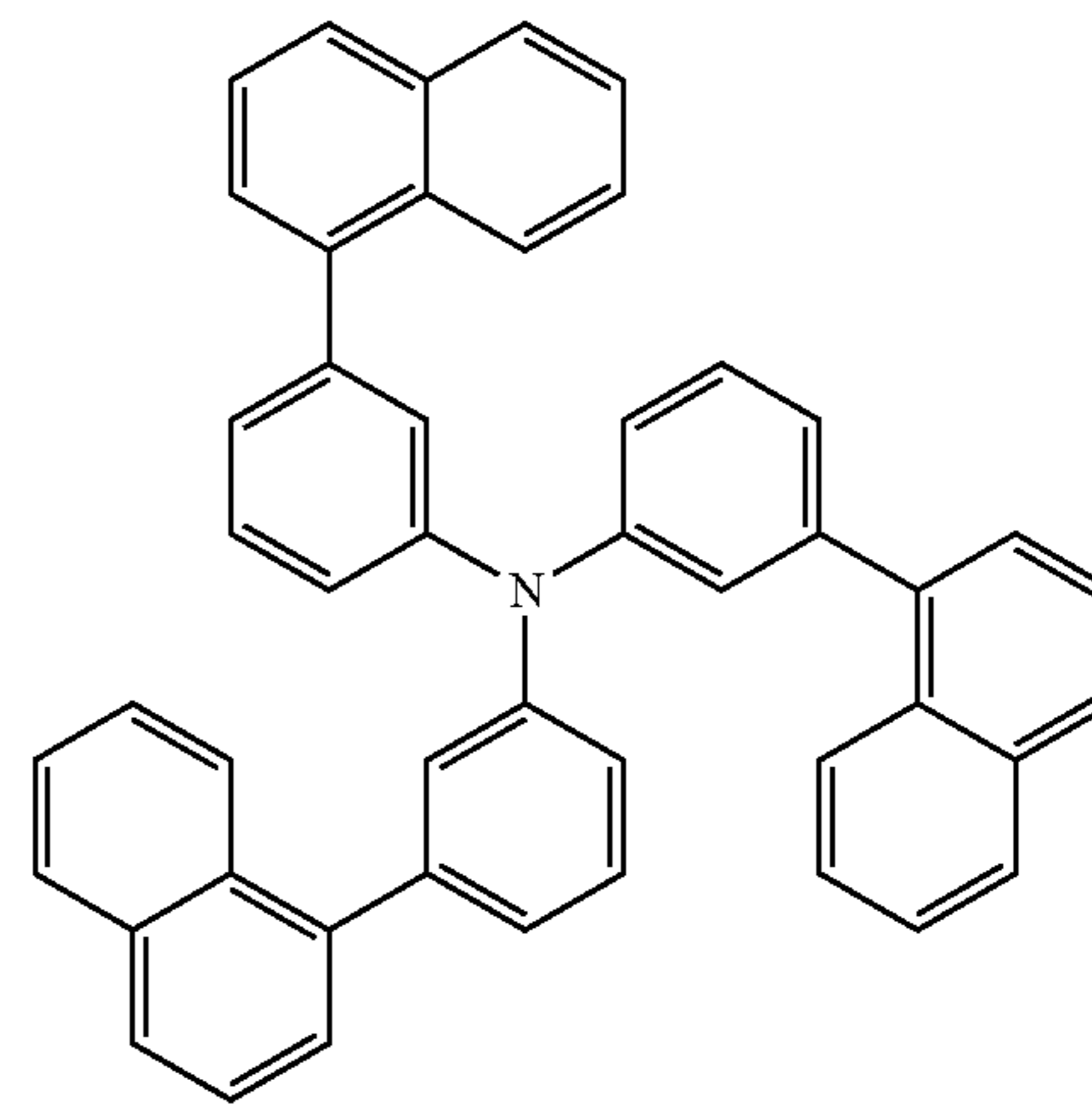
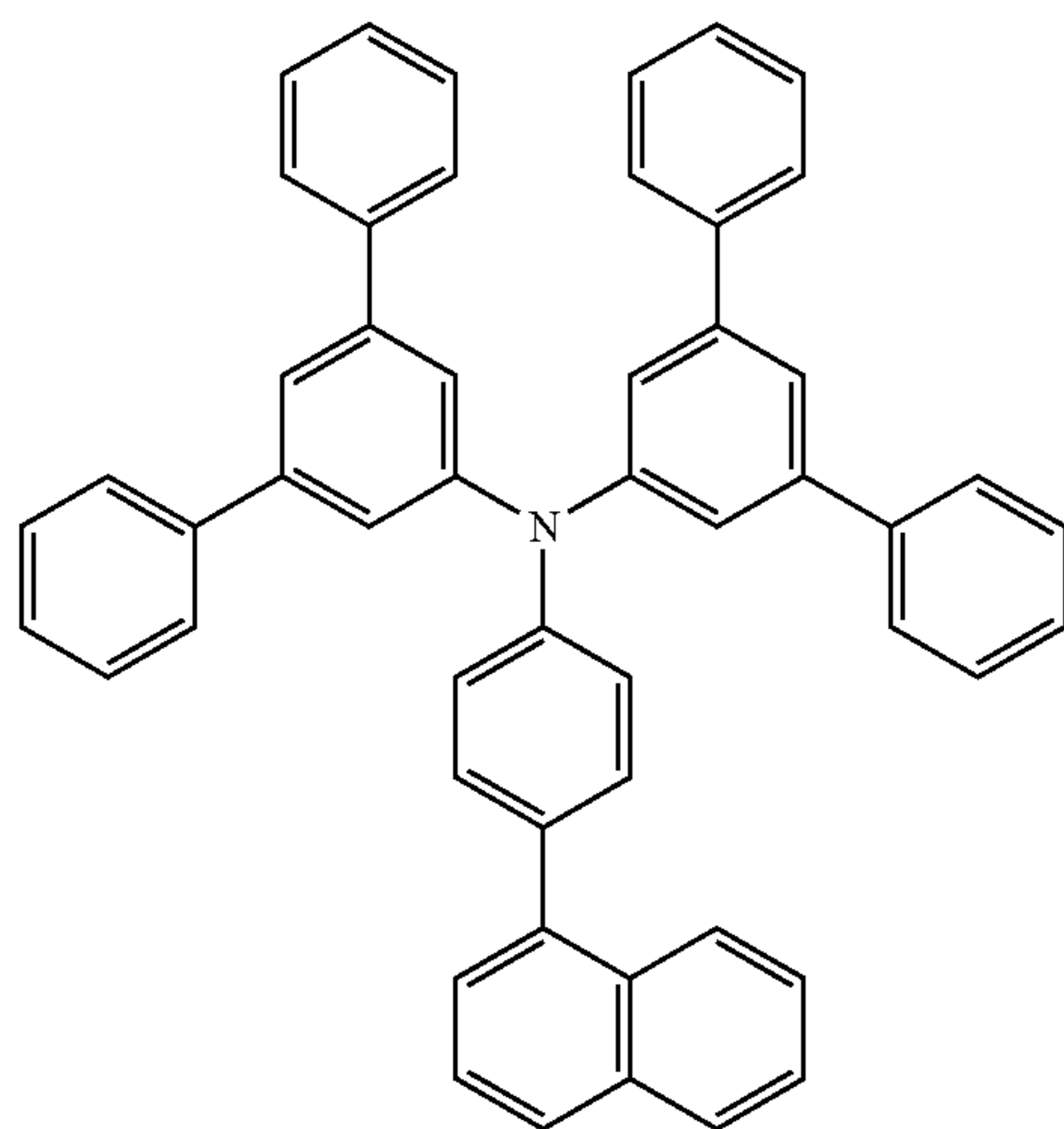
1-11'

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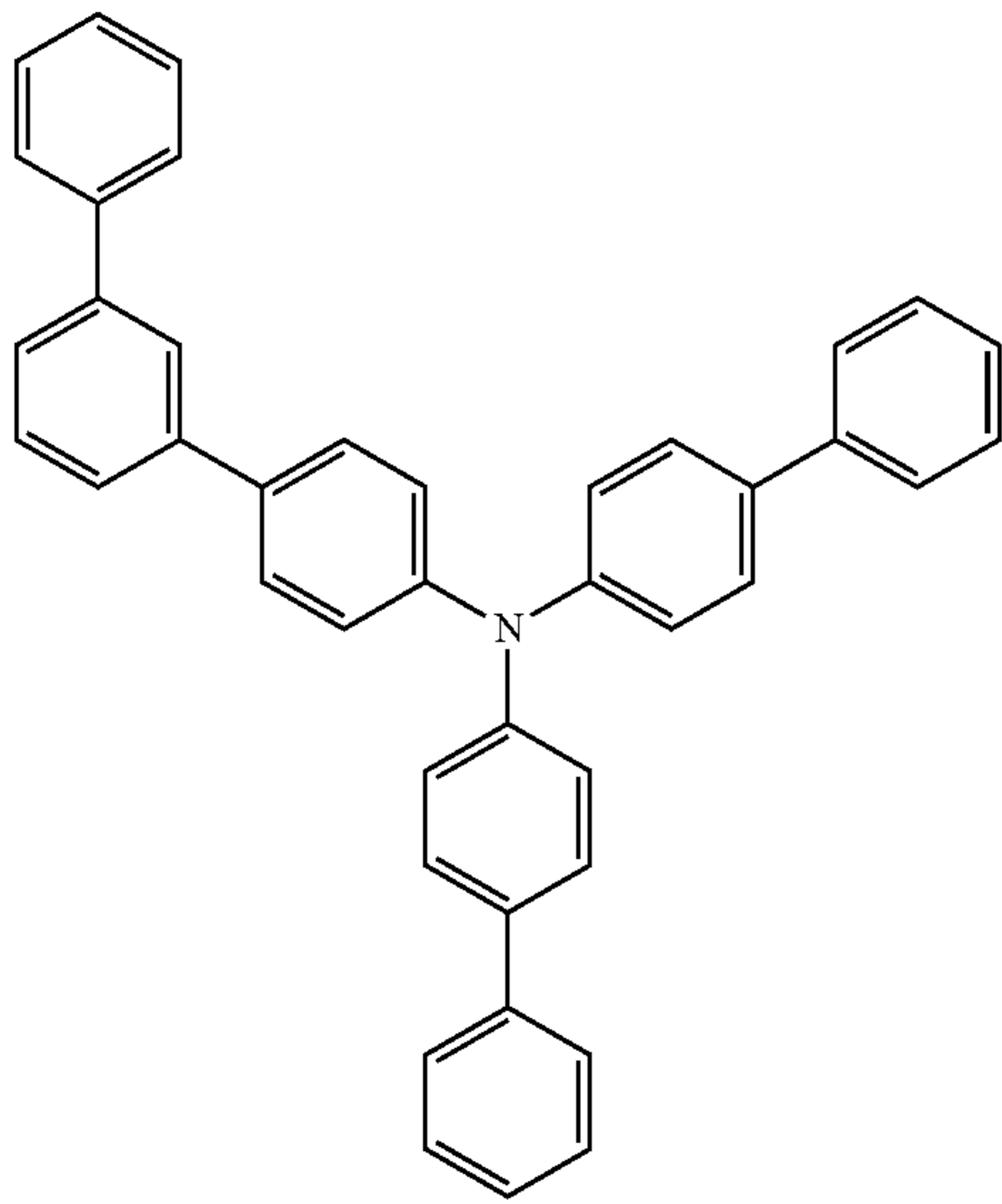
65



1-14'

33

-continued



1-15'

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1-16'

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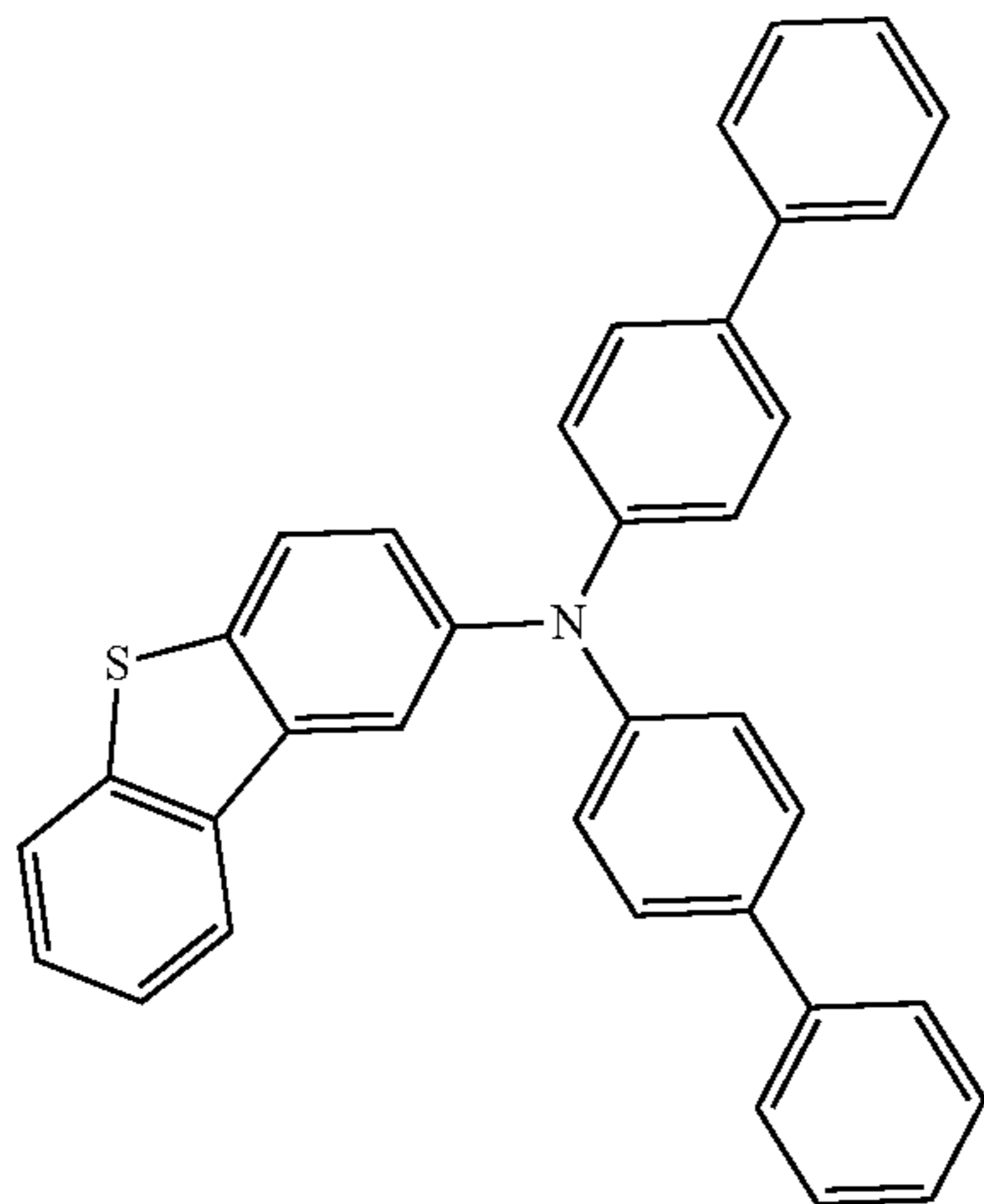
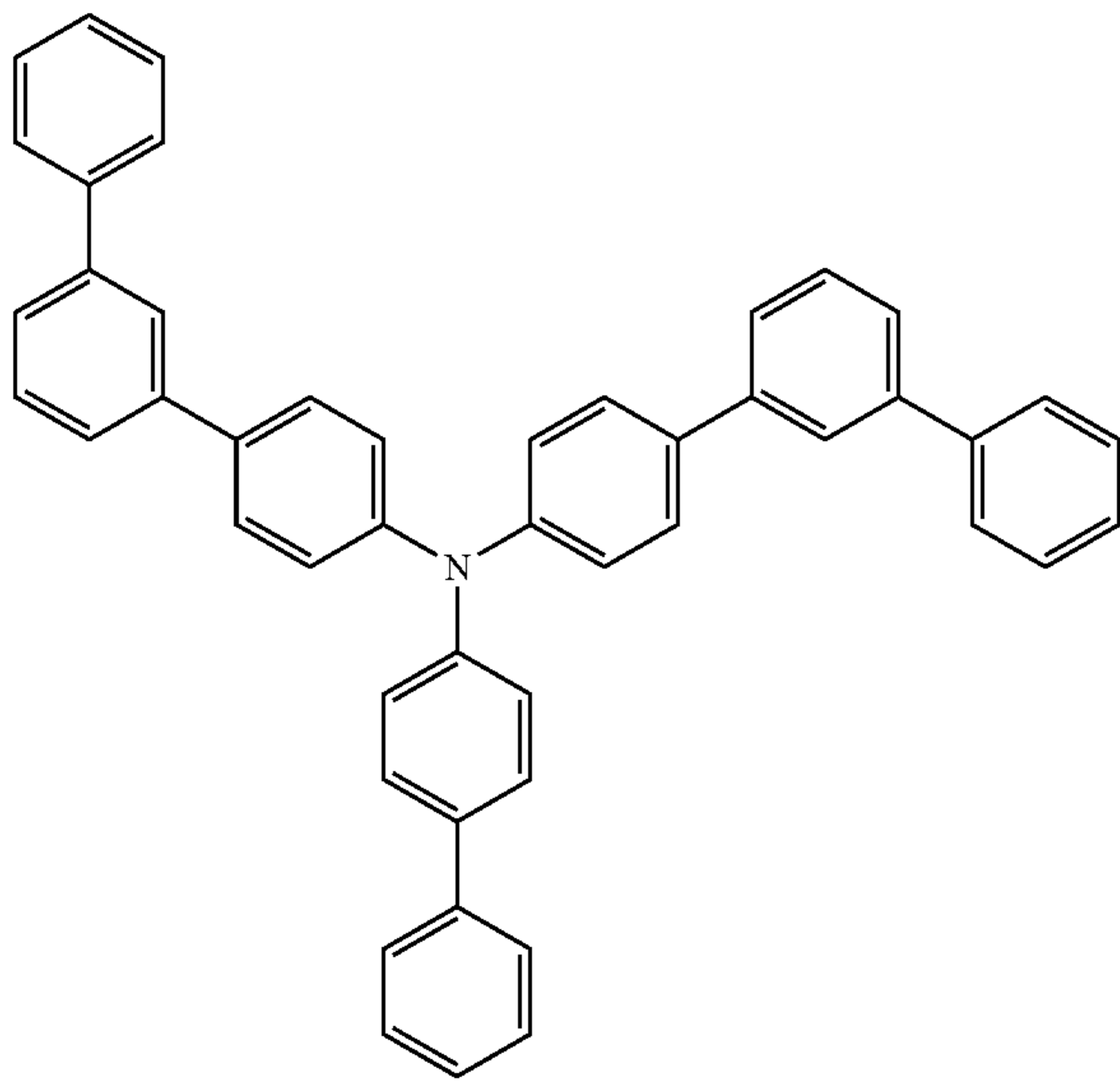
1-17'

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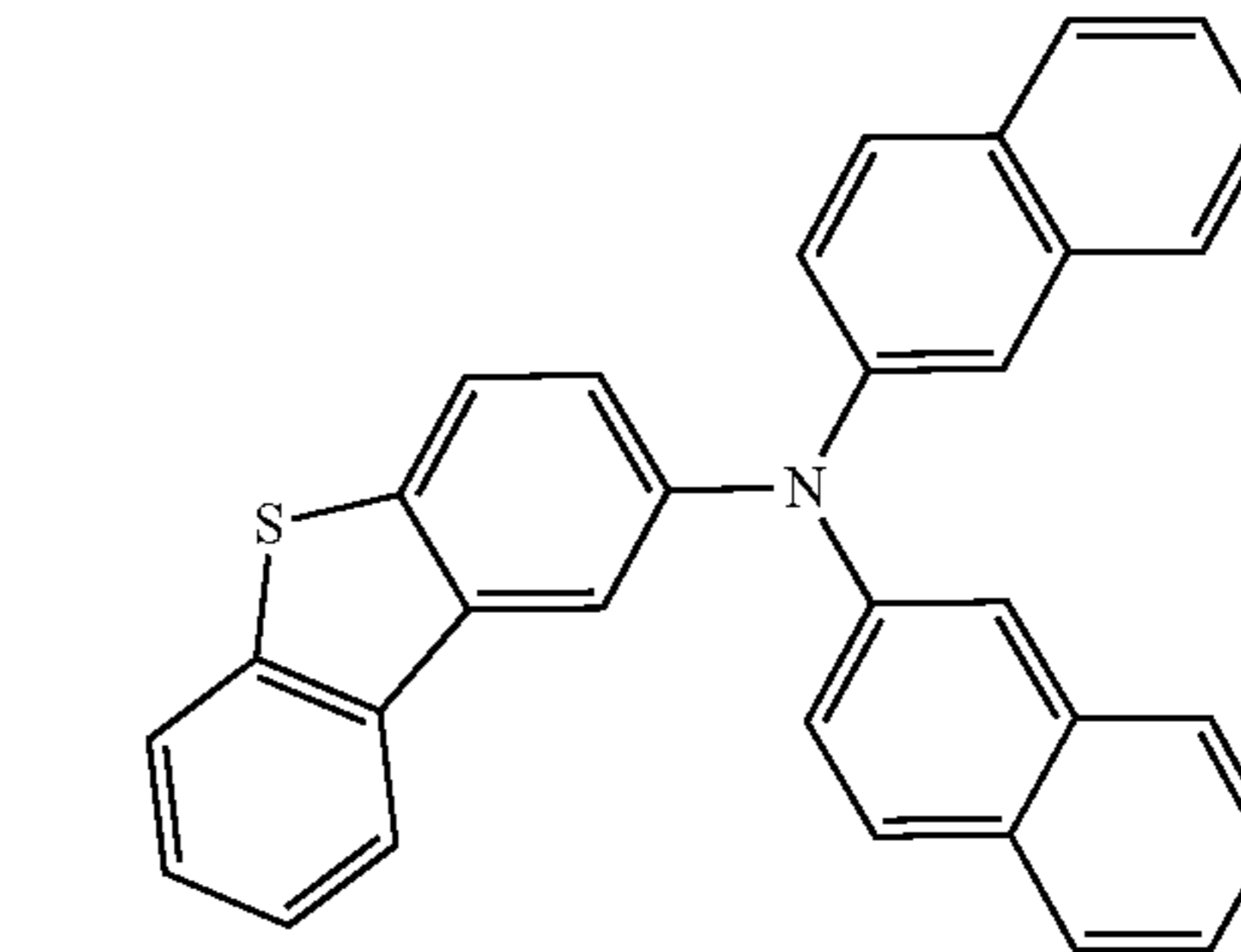
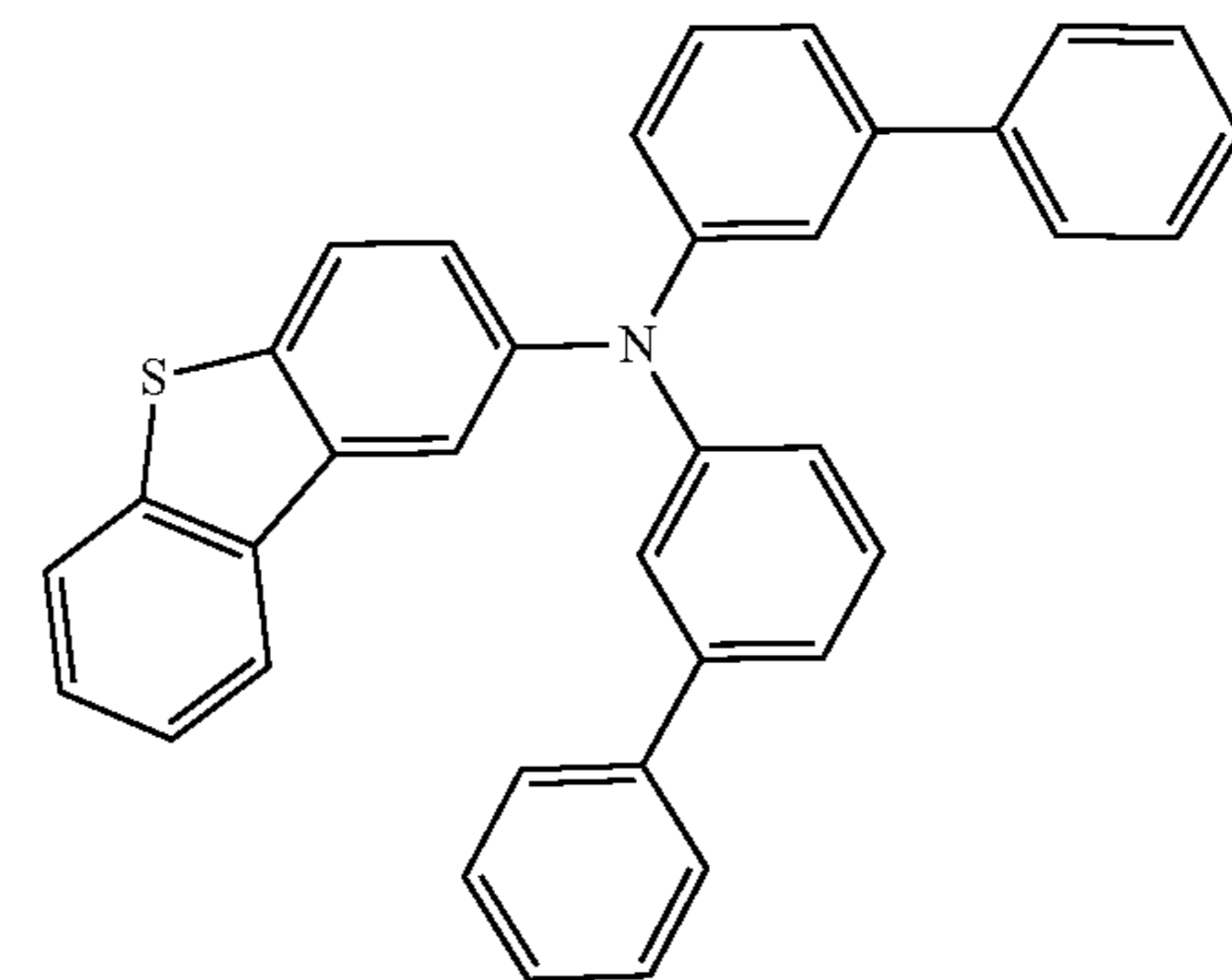
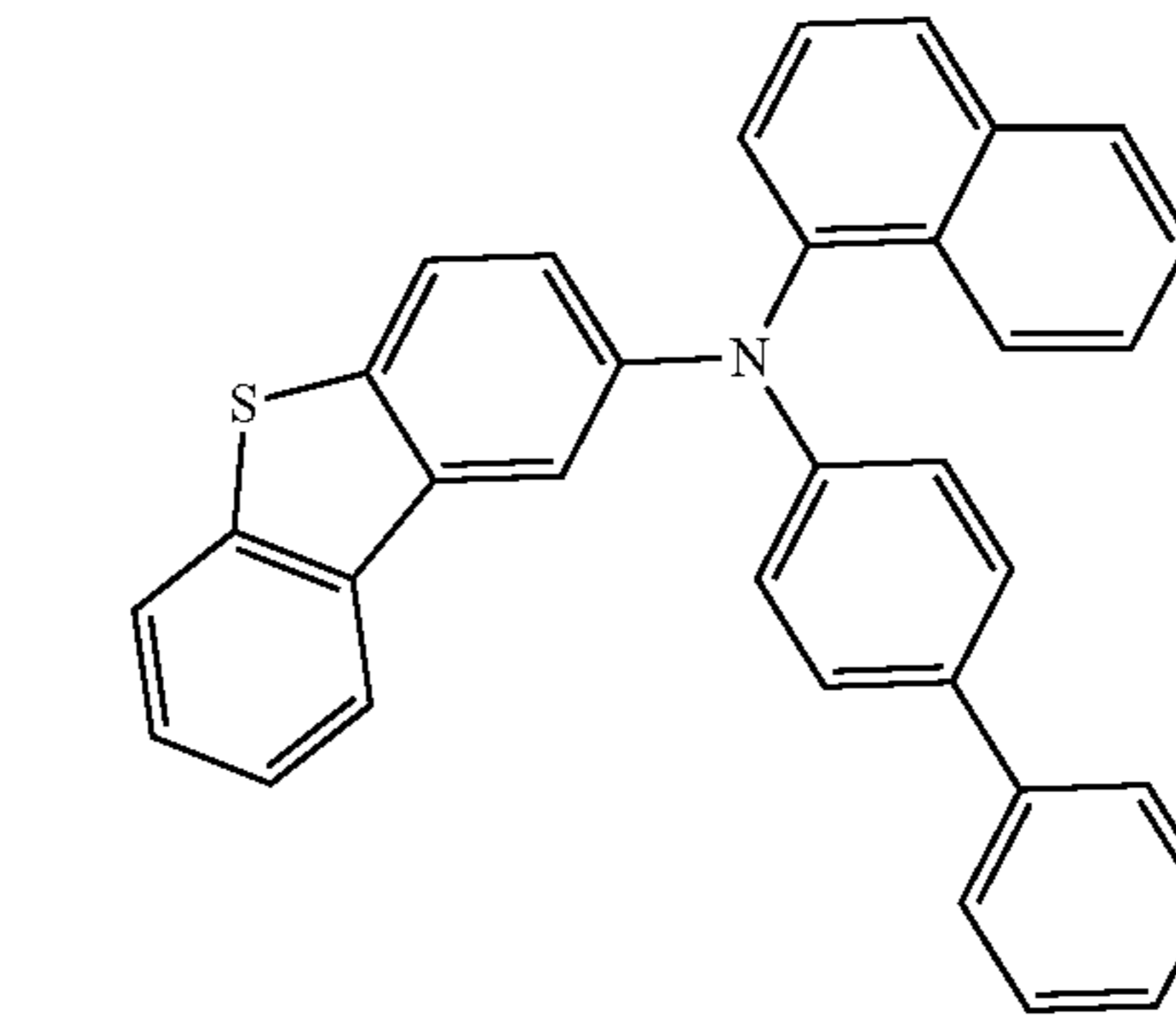
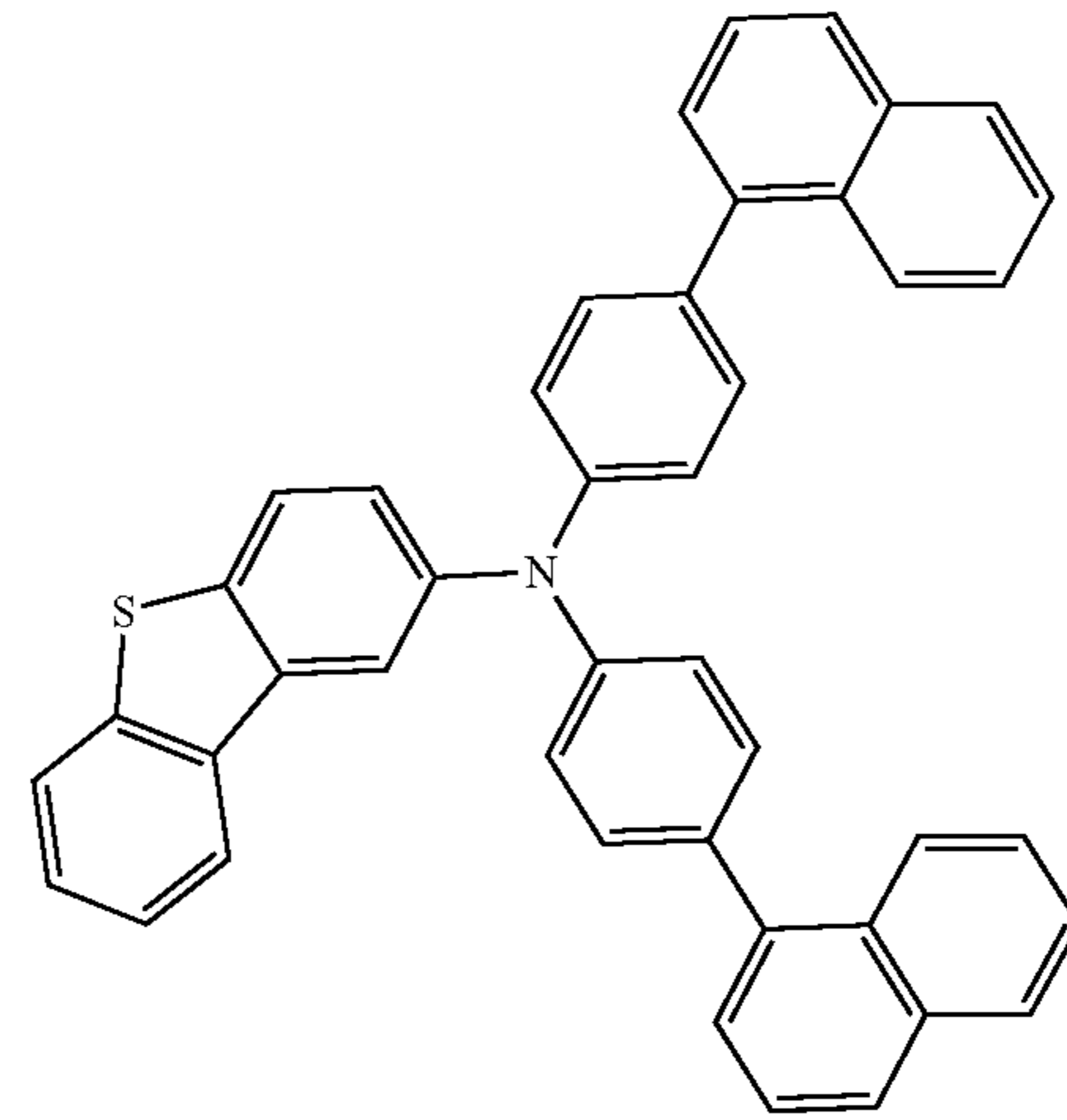
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65



34

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1-18'

1-19'

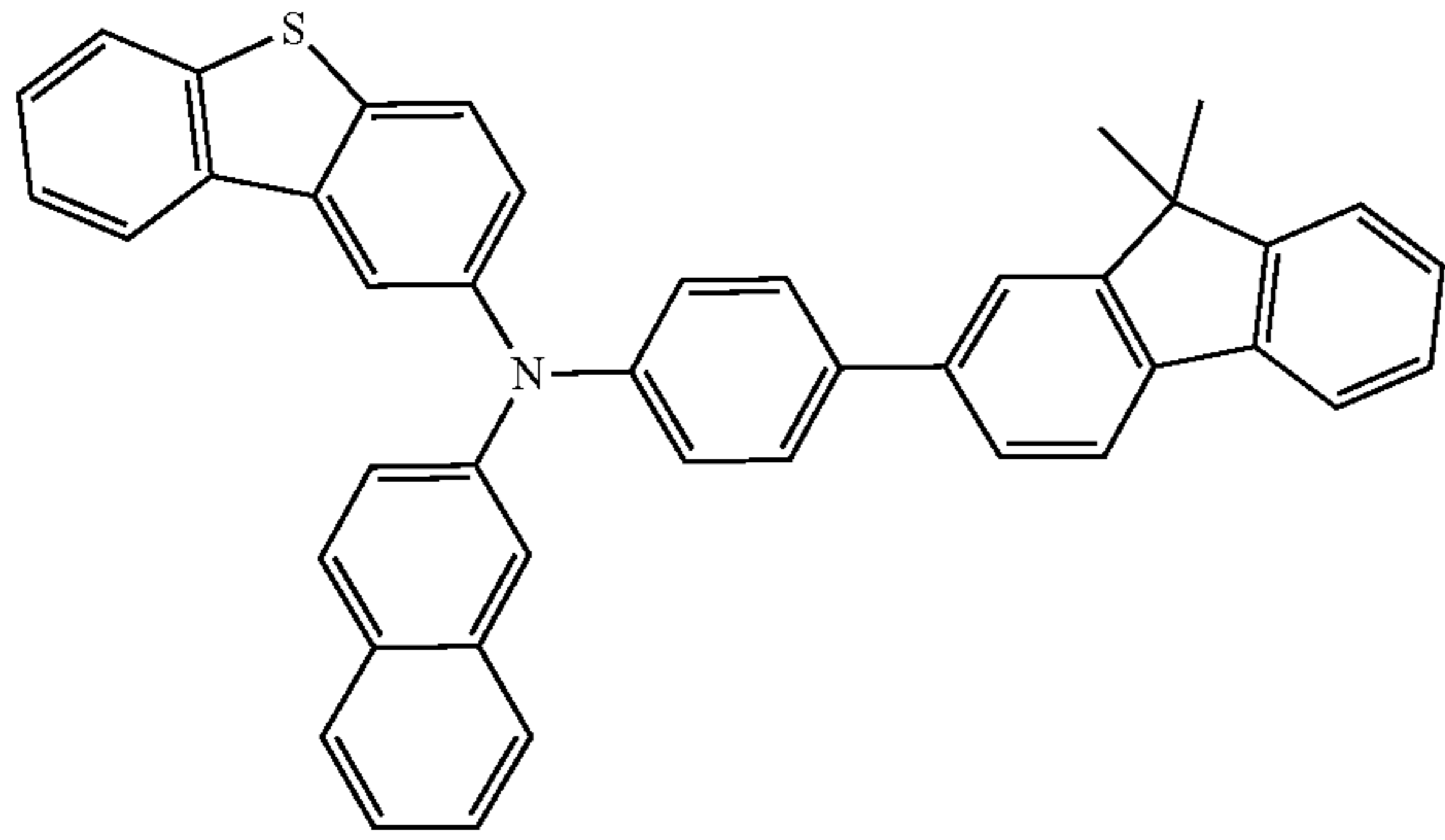
1-20'

1-21'

35

-continued

1-22'

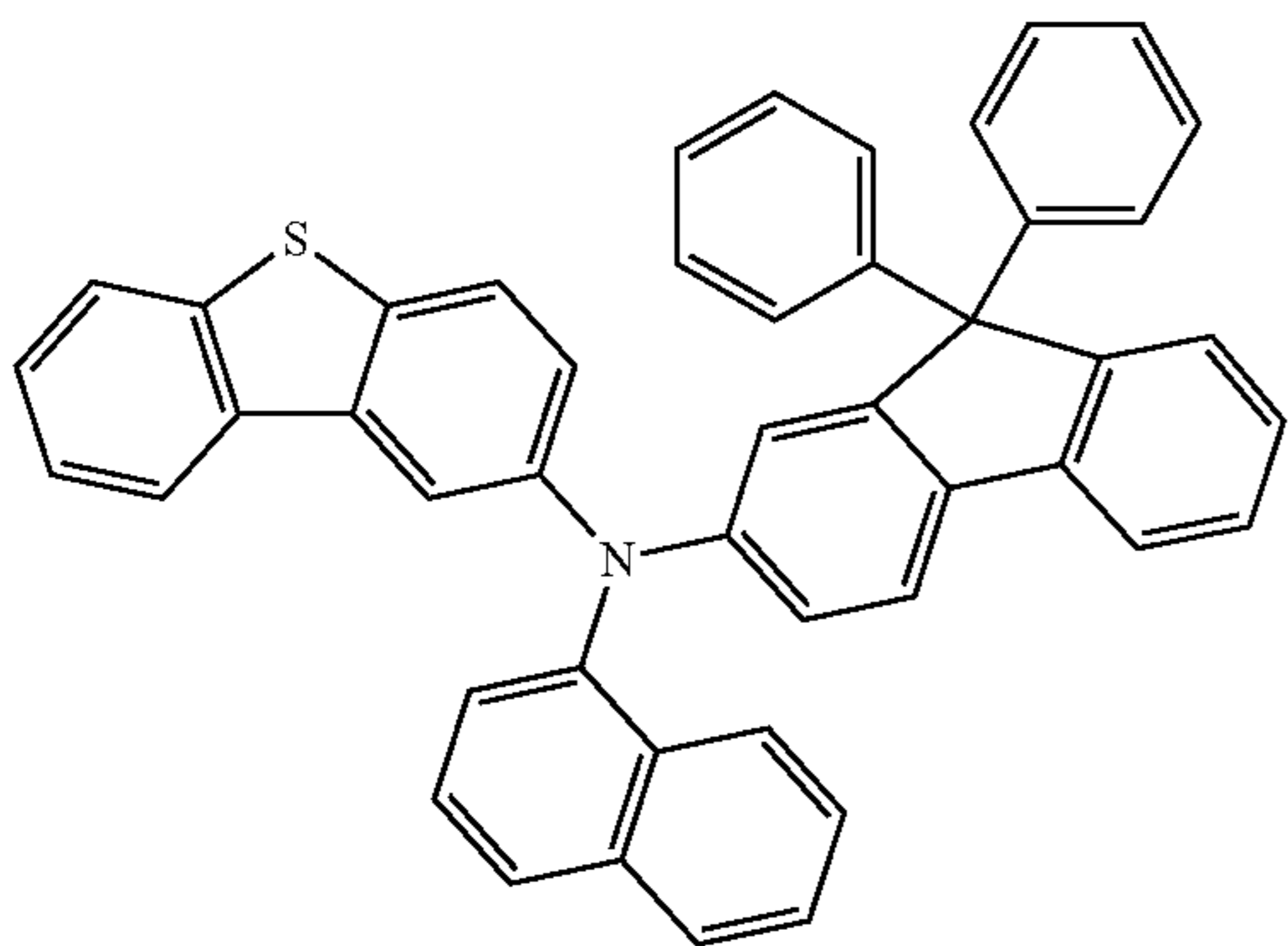


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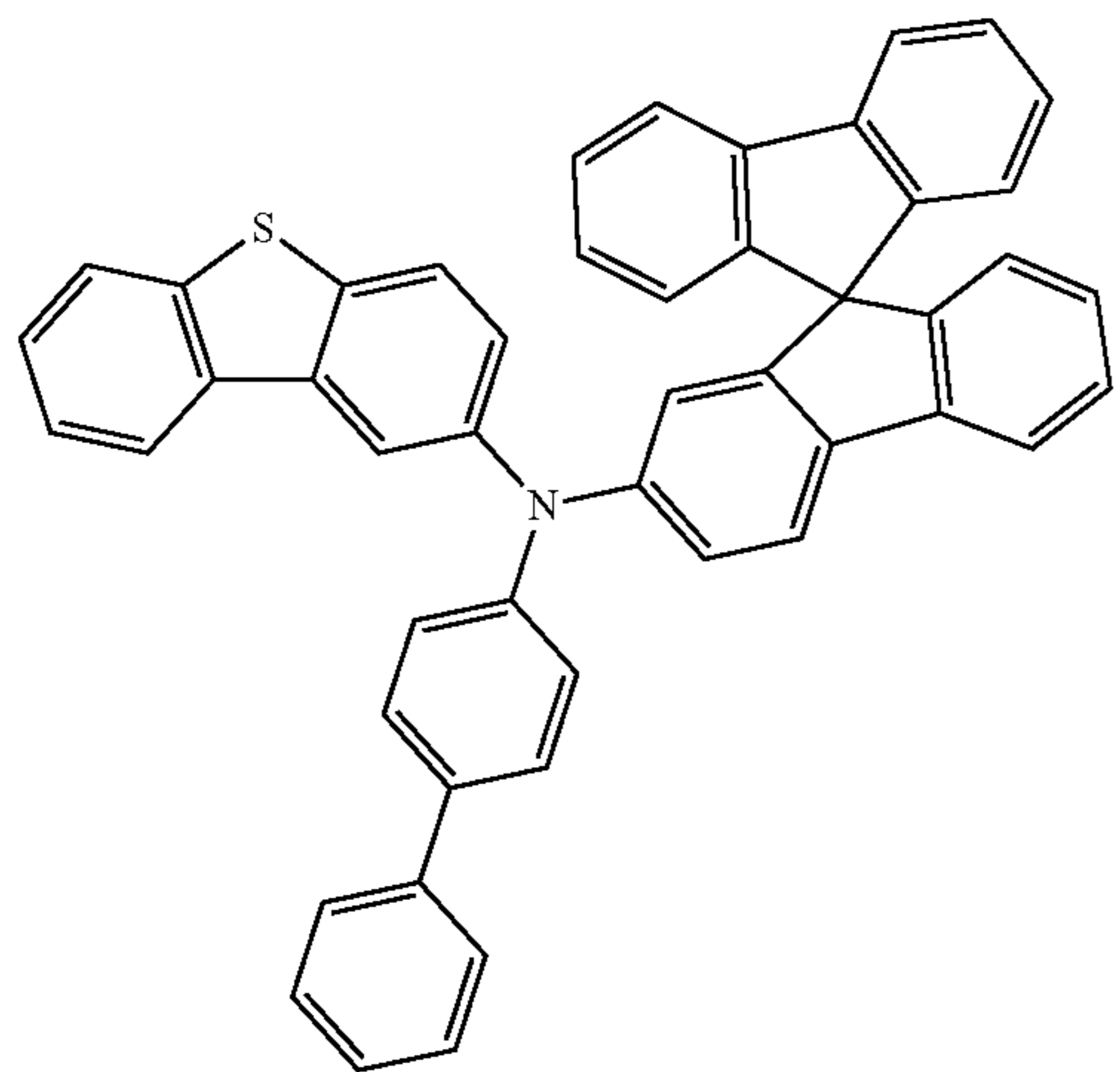
1-23'



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1-24'



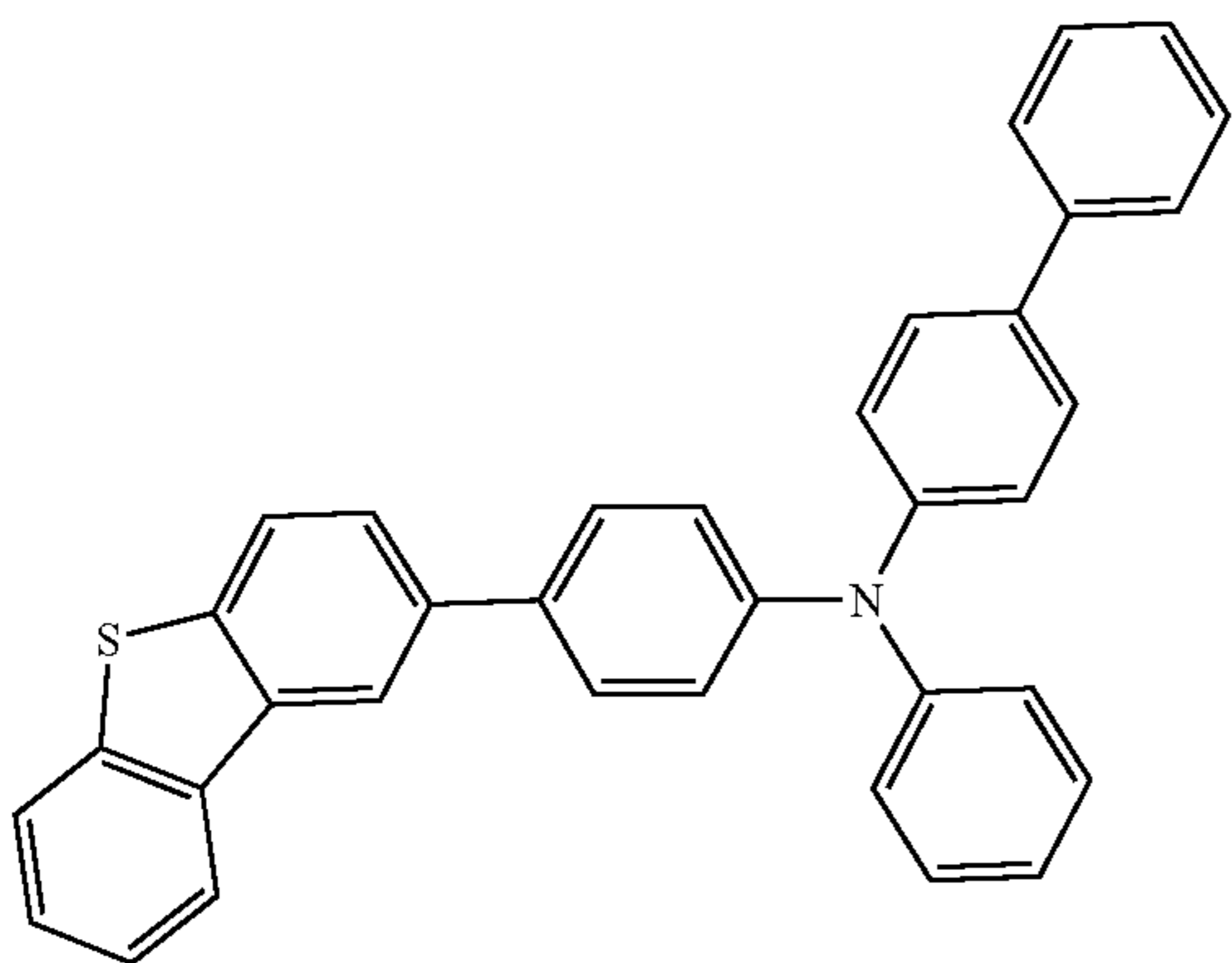
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1-25'



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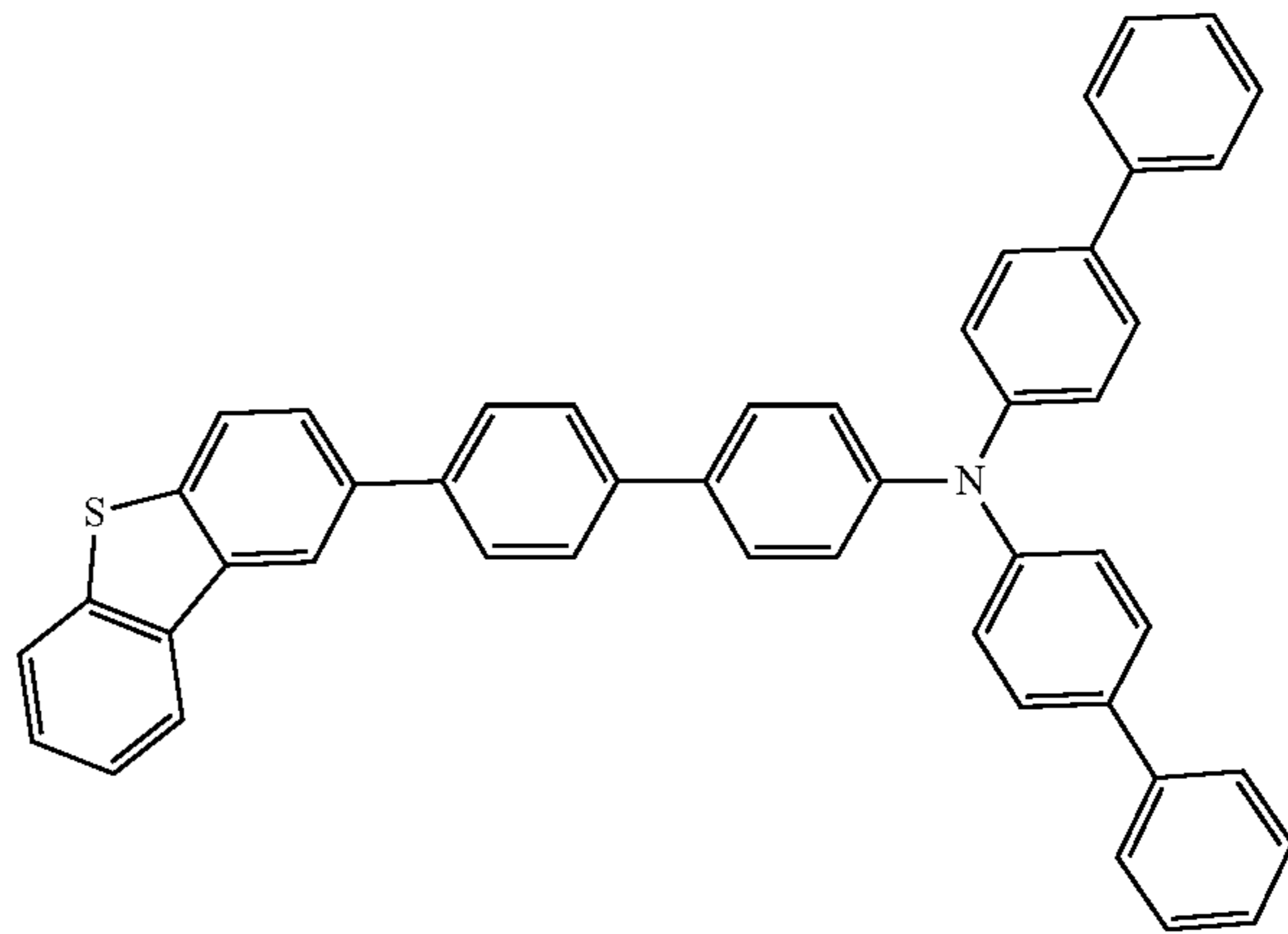
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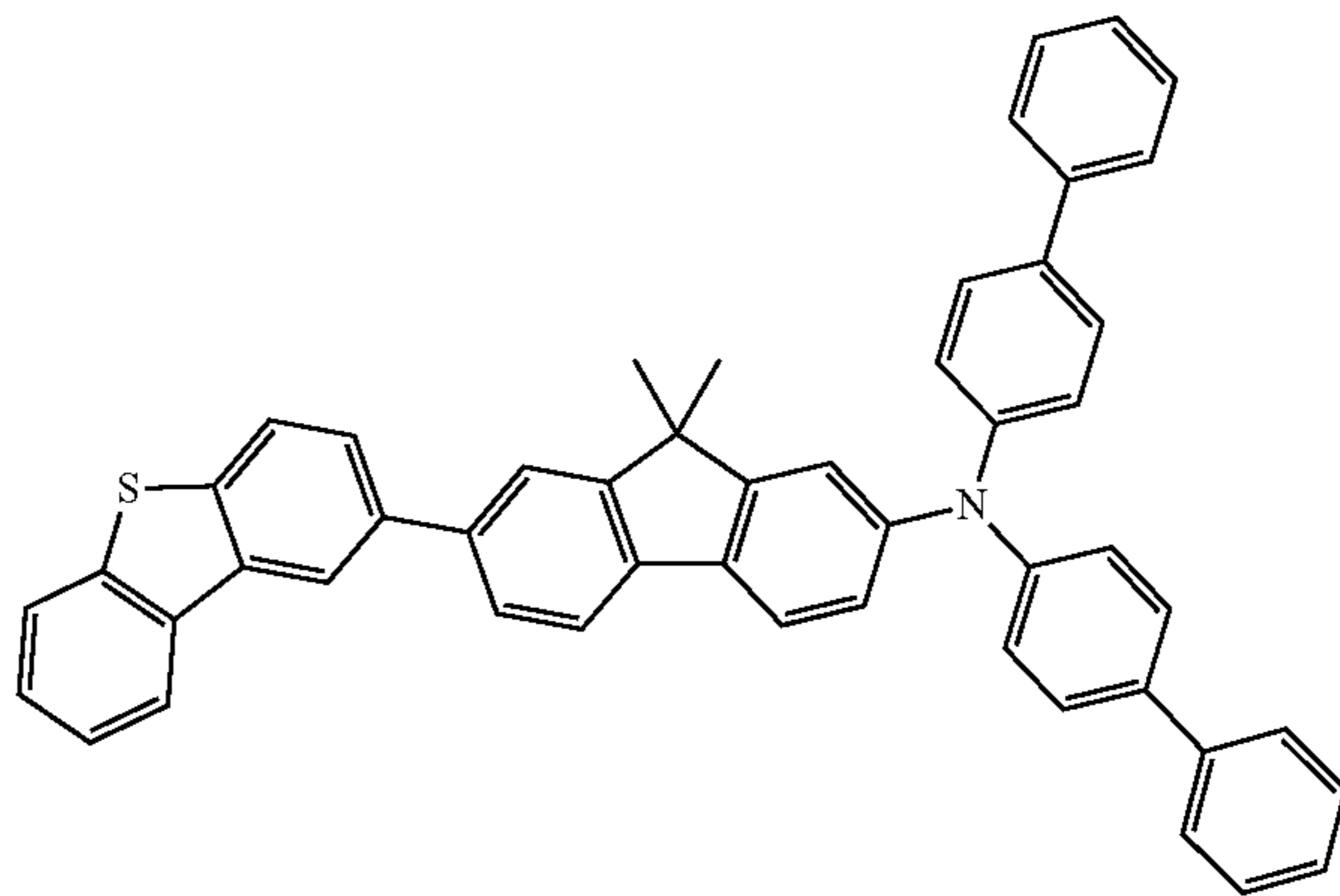
36

-continued

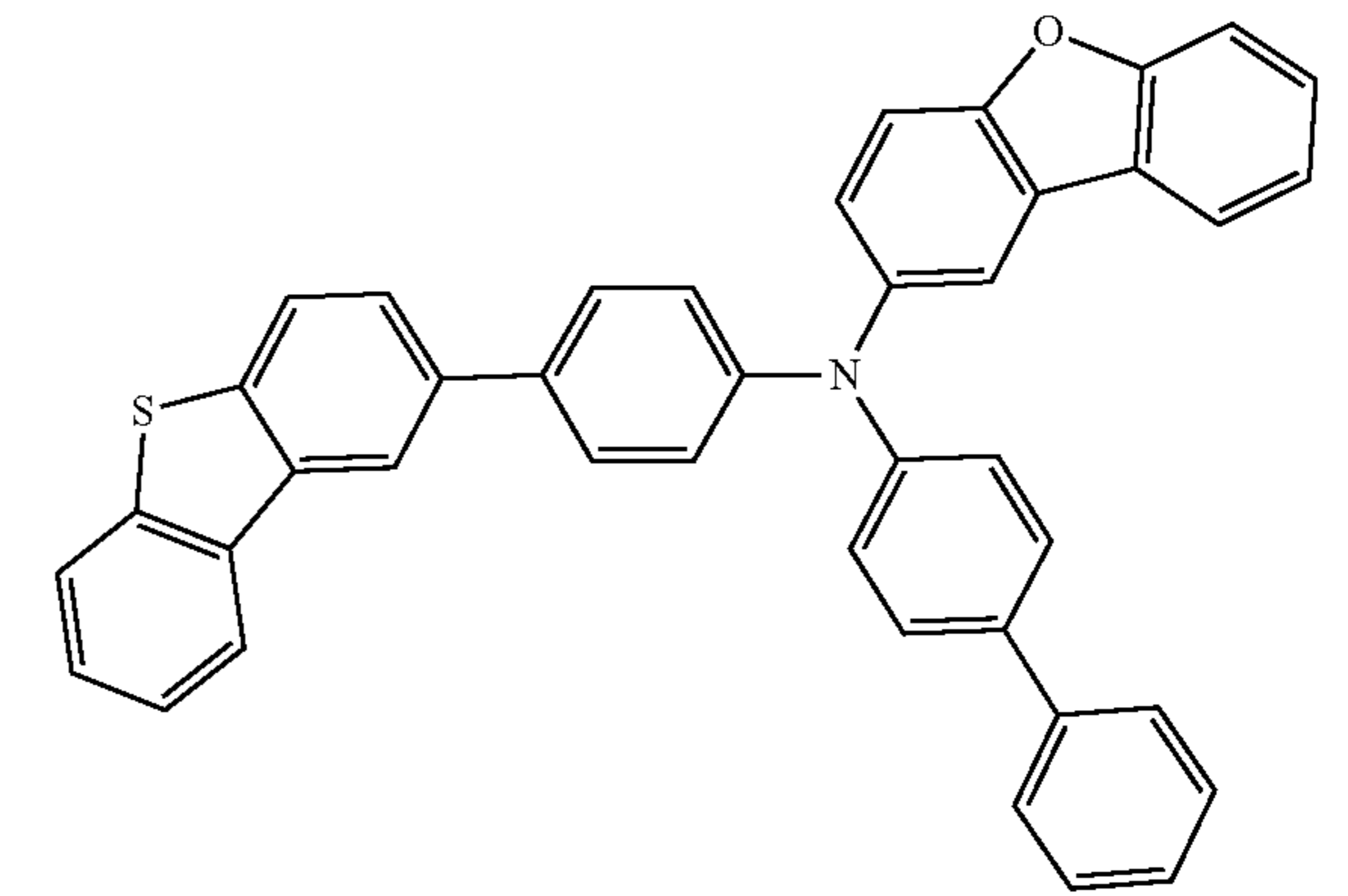
1-26'



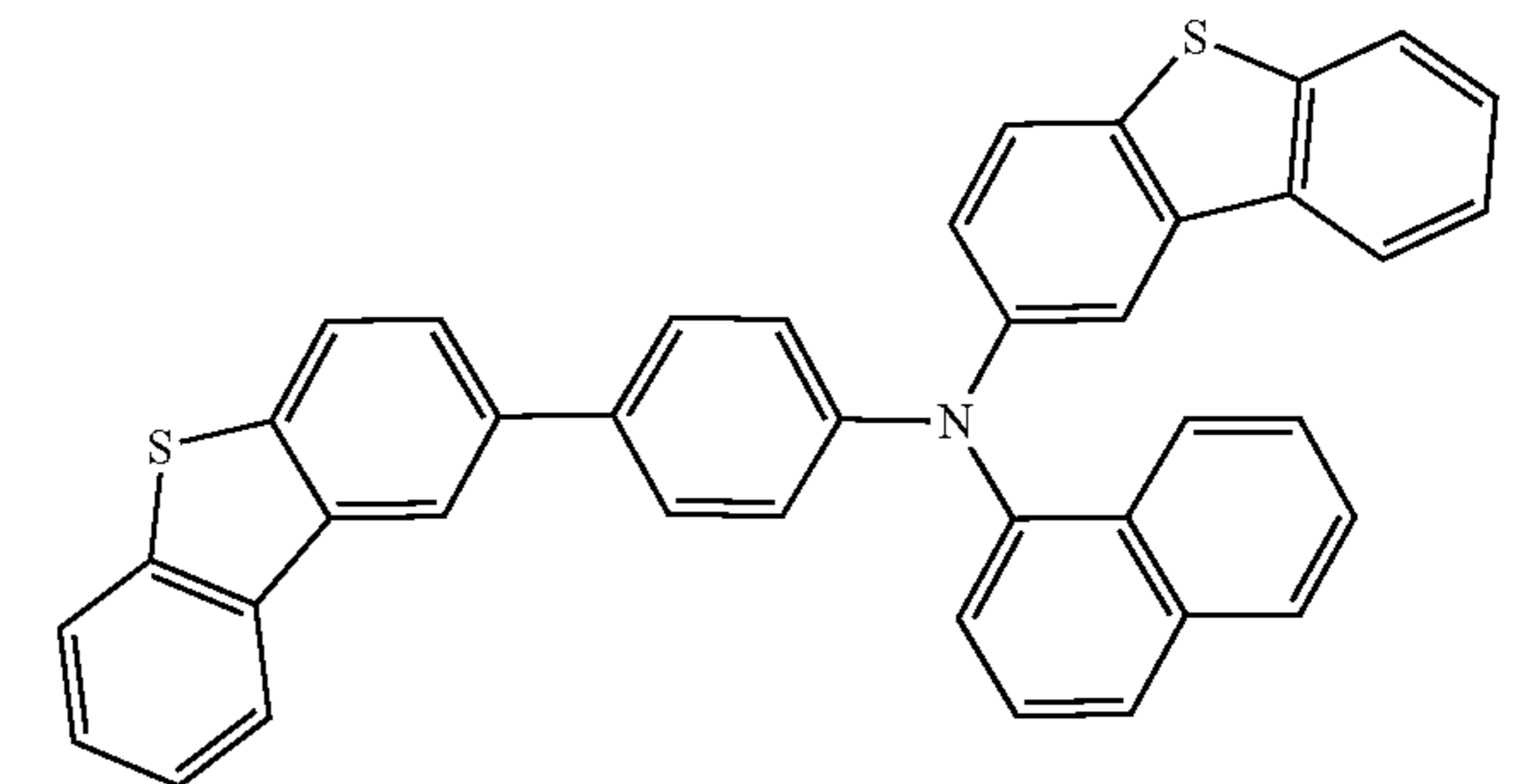
1-27'



1-28'



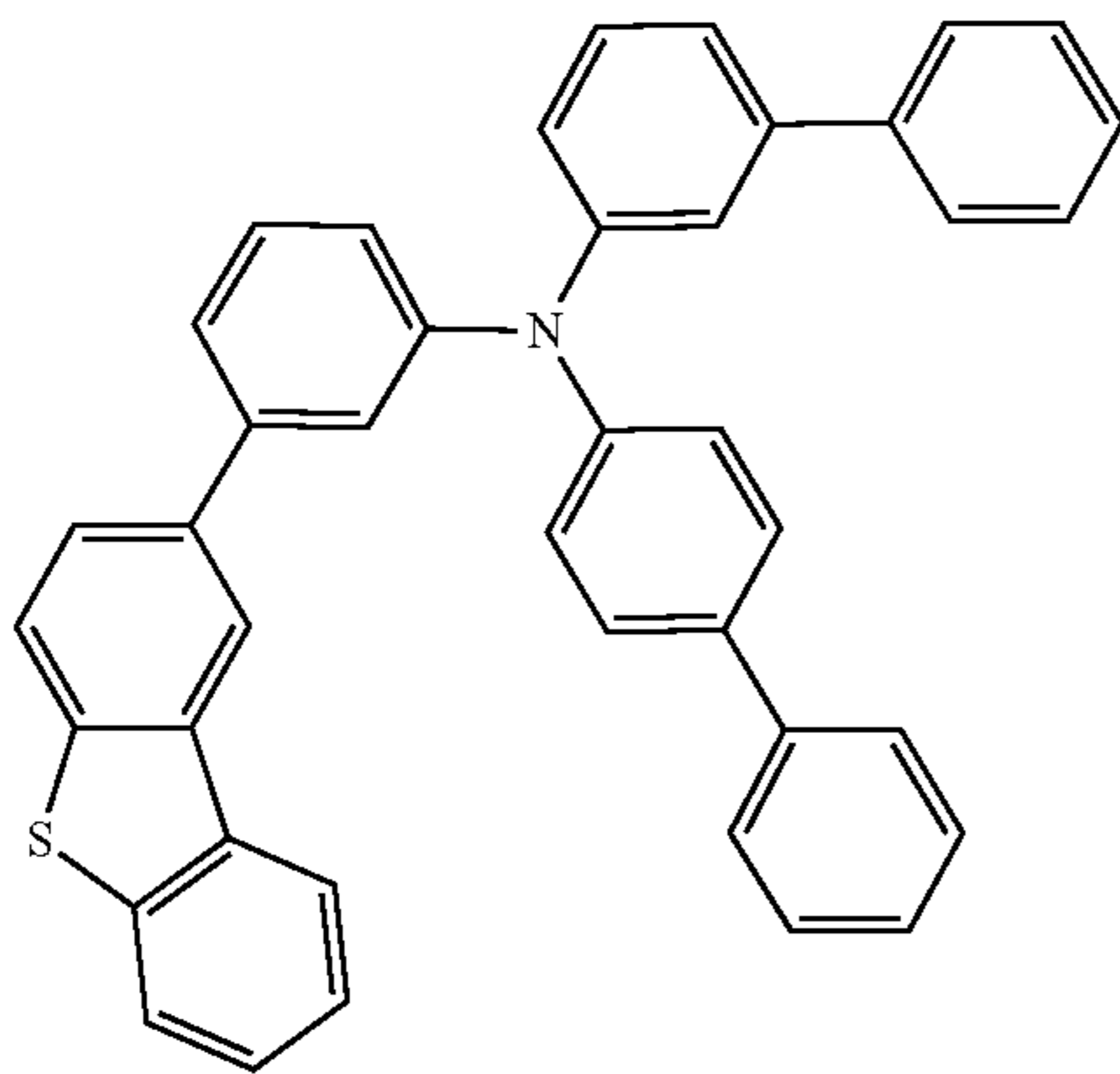
1-29'



37

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1-30'



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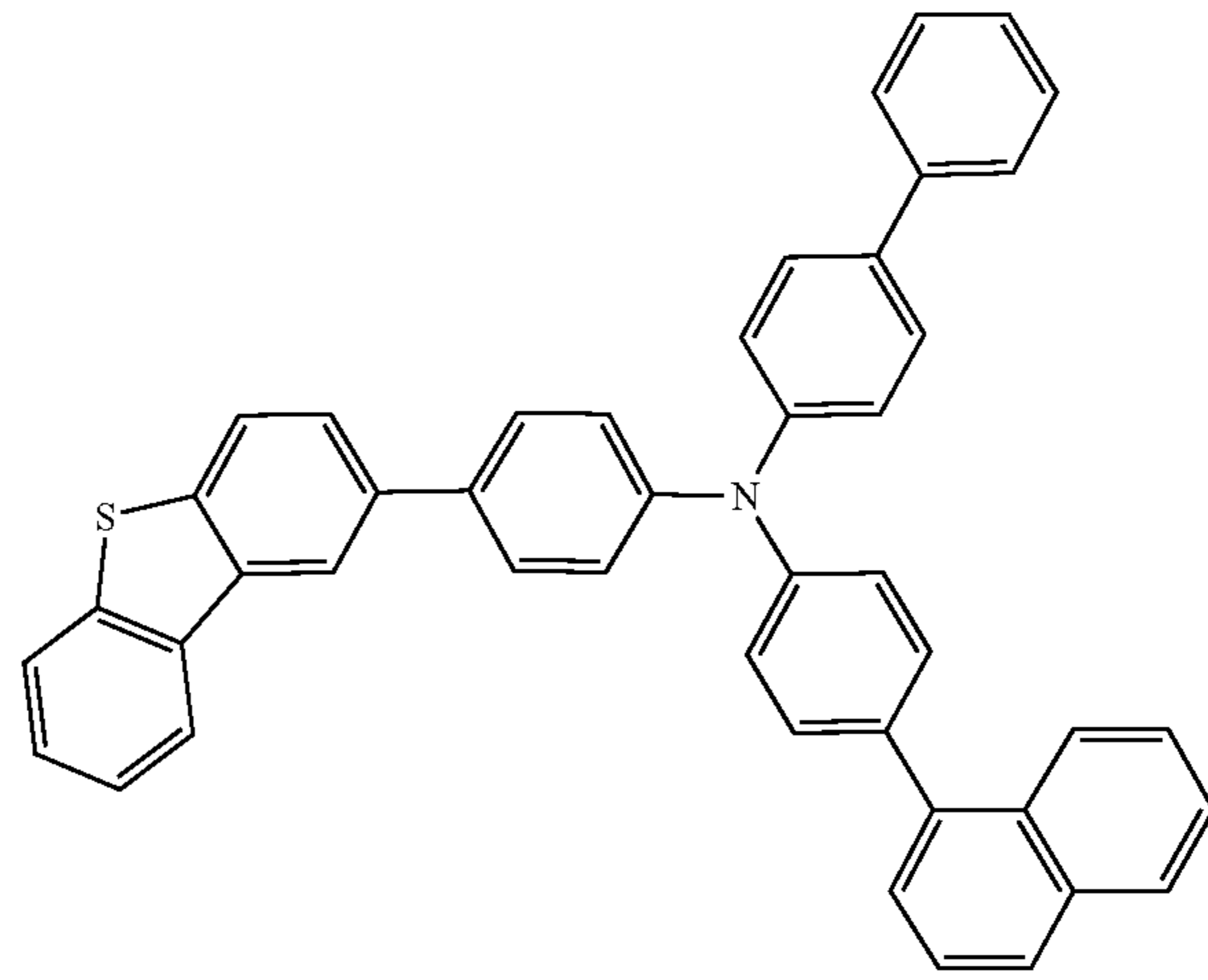
15

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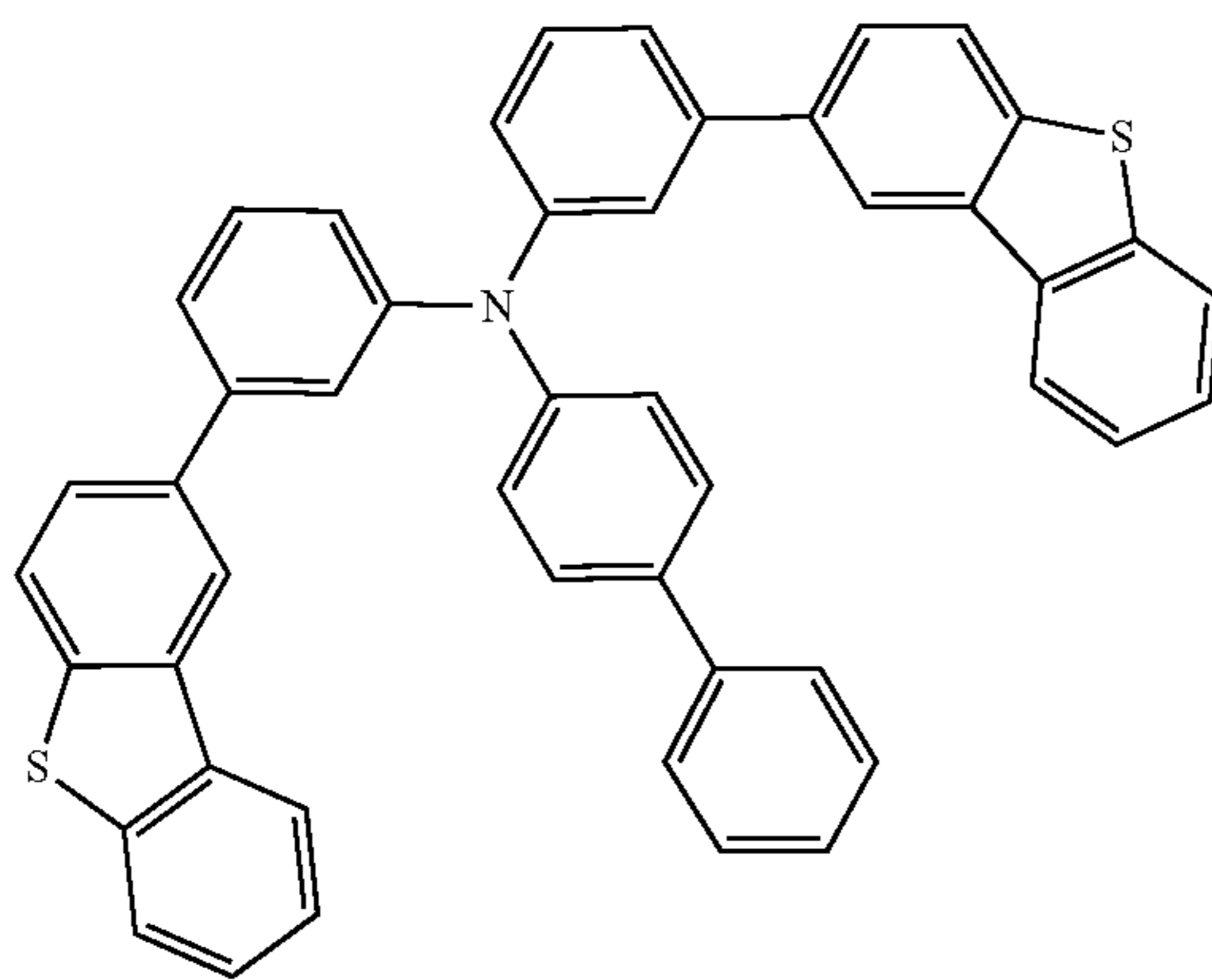
38

-continued

1-33'



1-31' 25



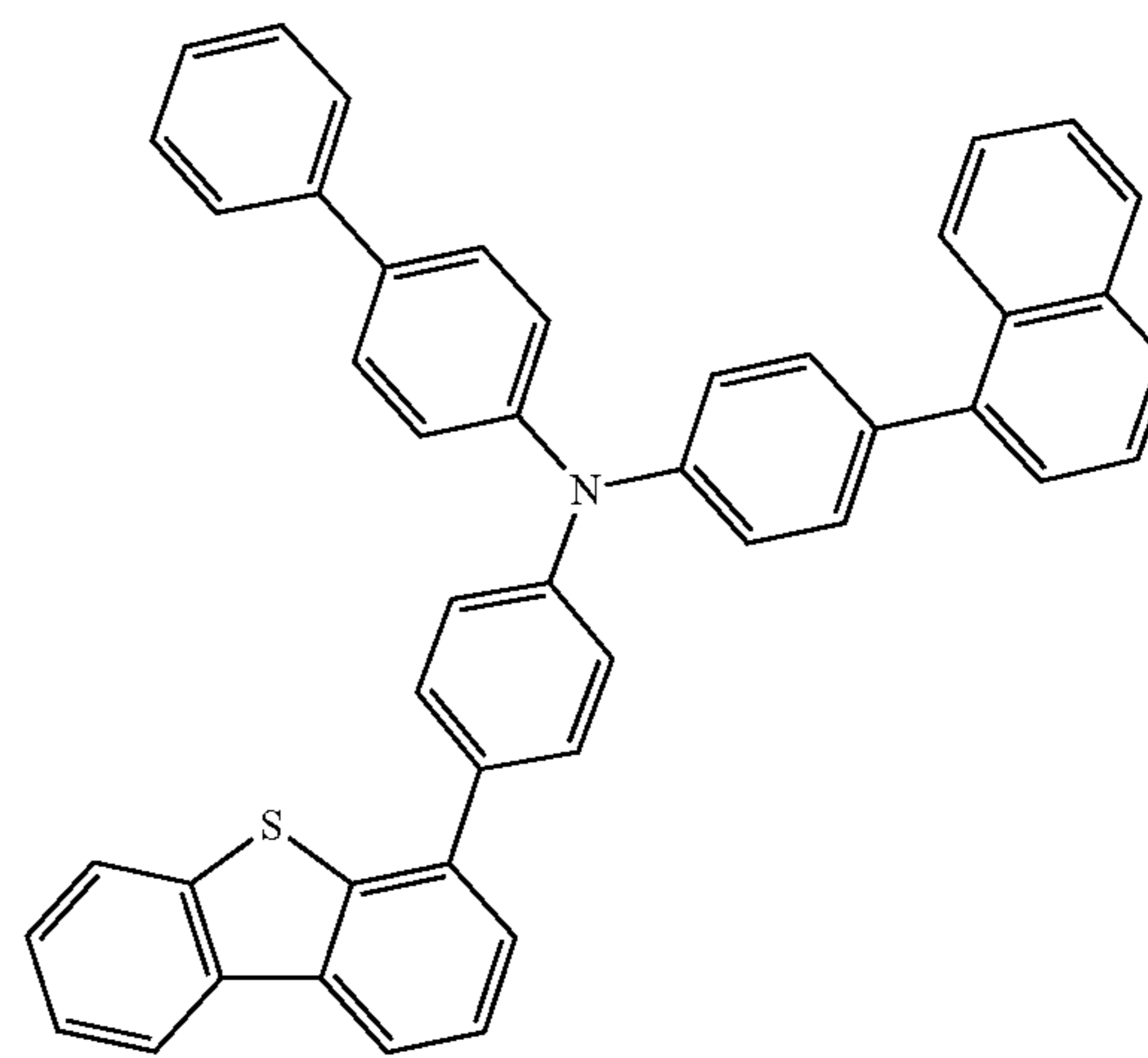
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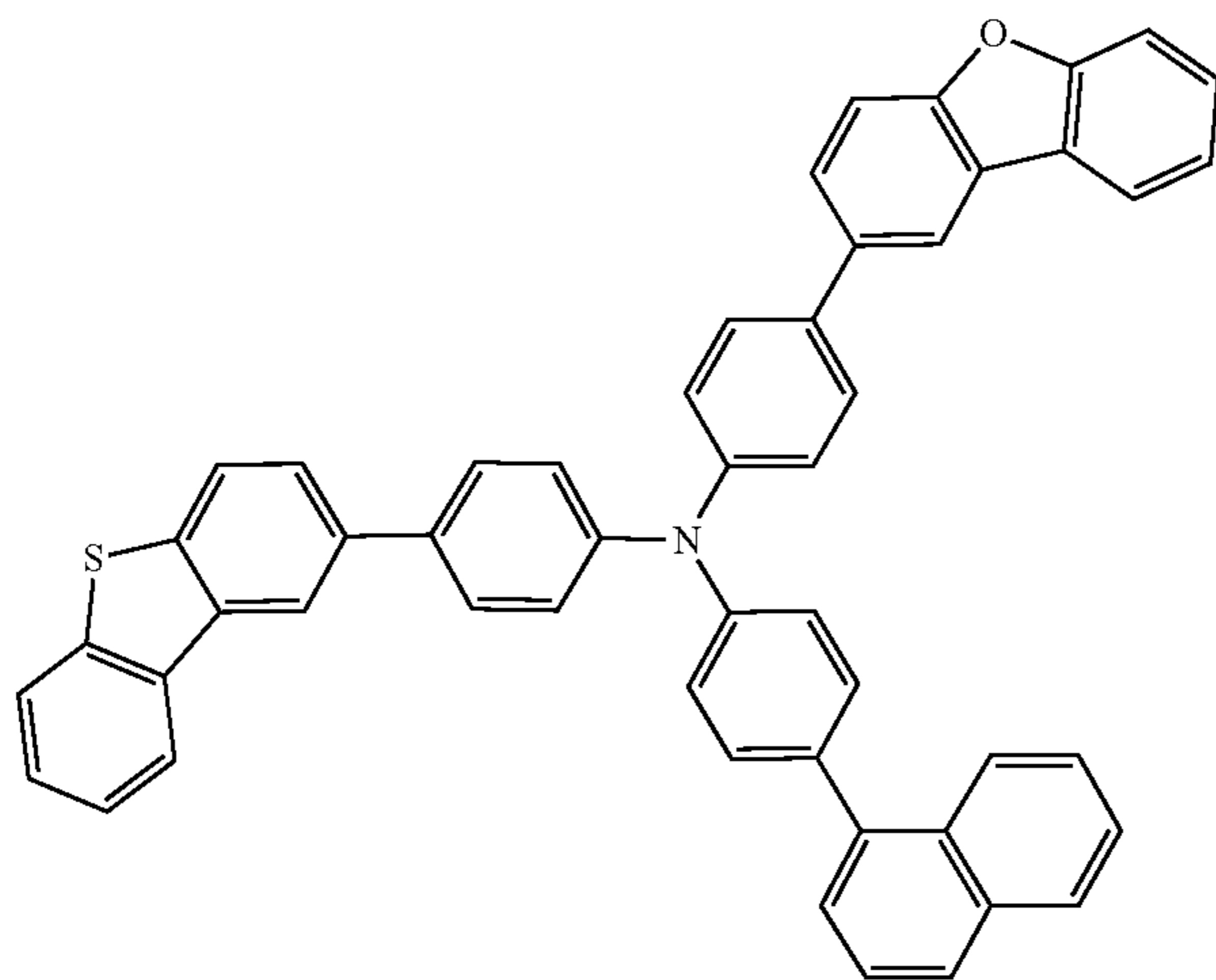
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1-34'



1-32' 50

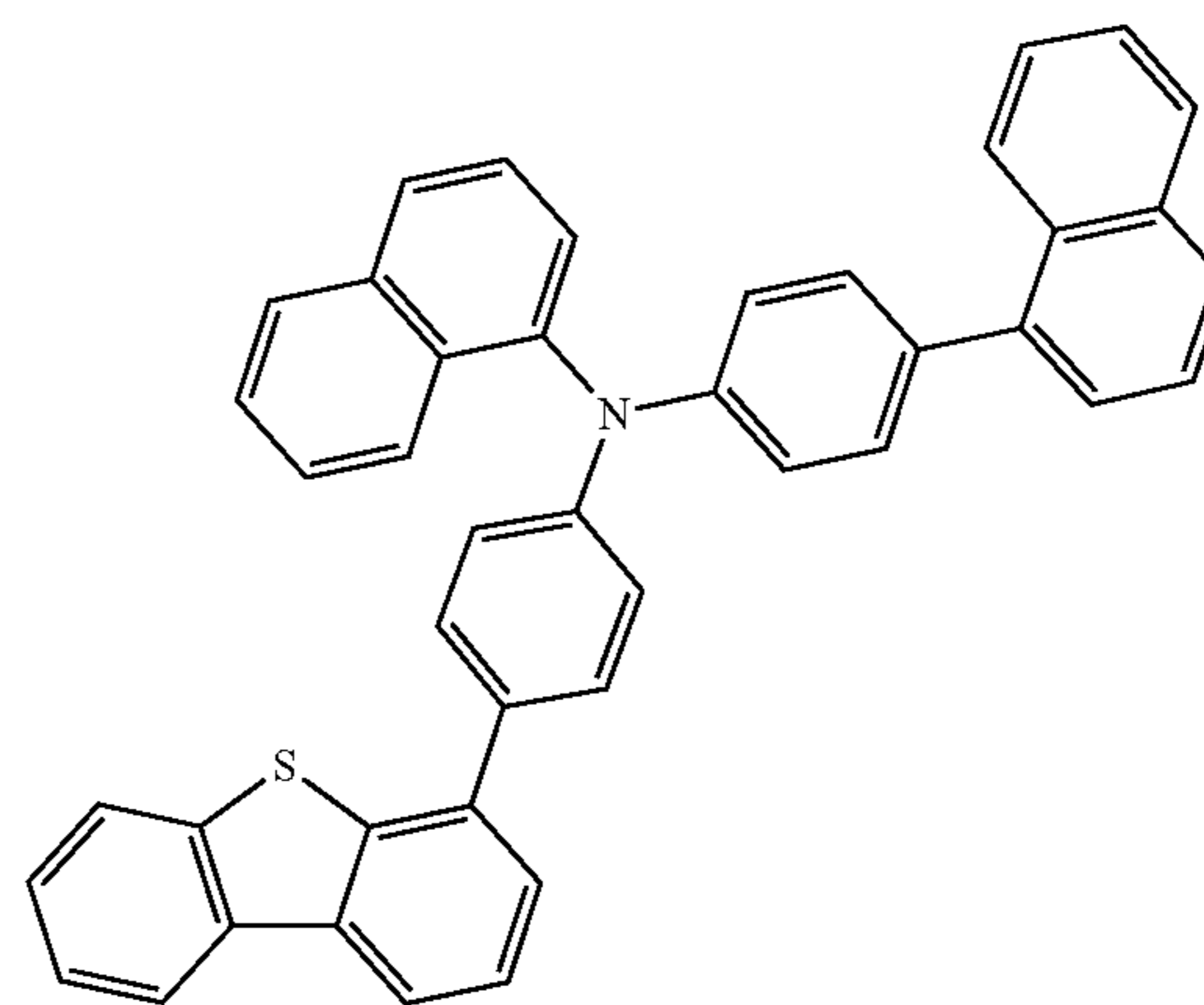


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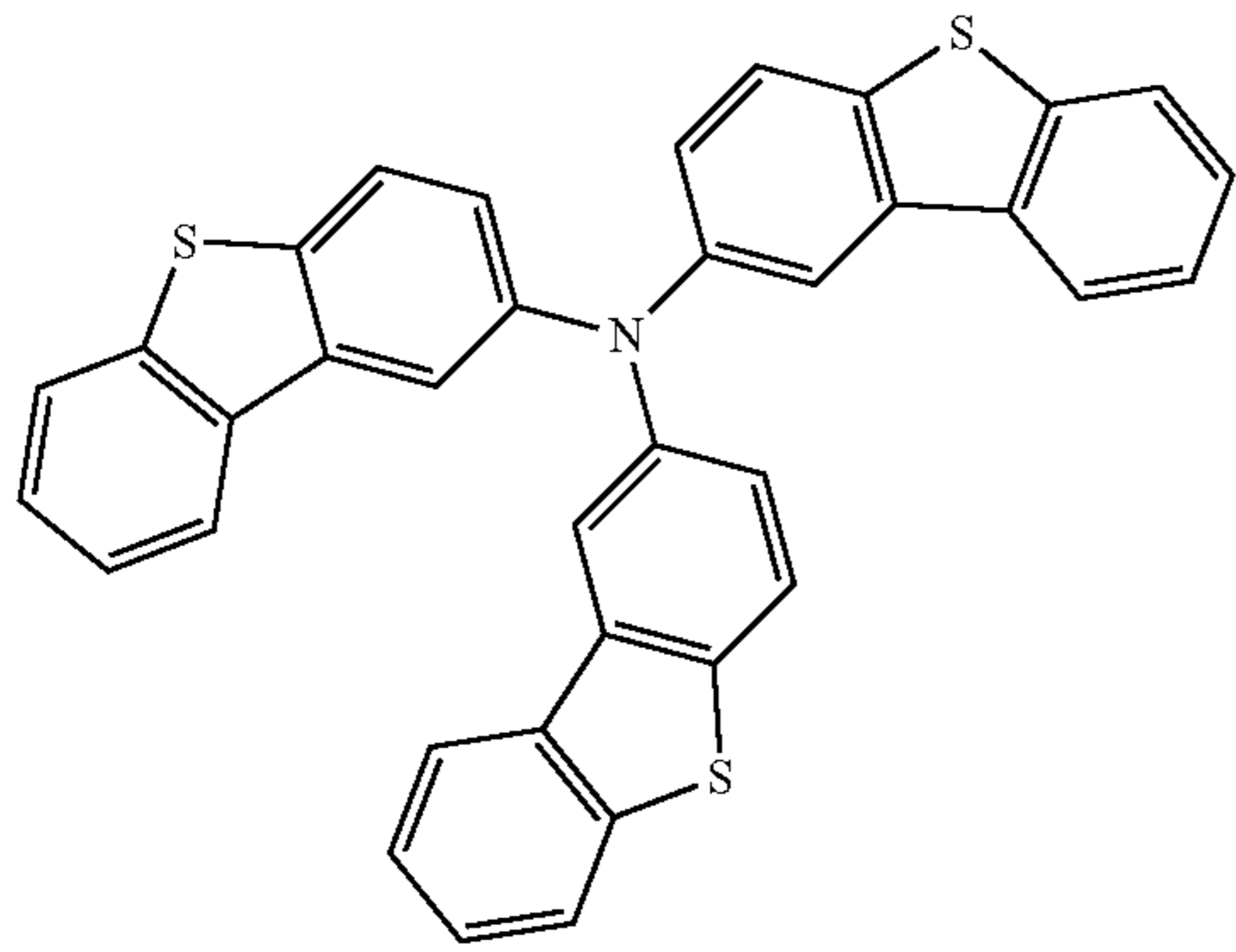
1-35'



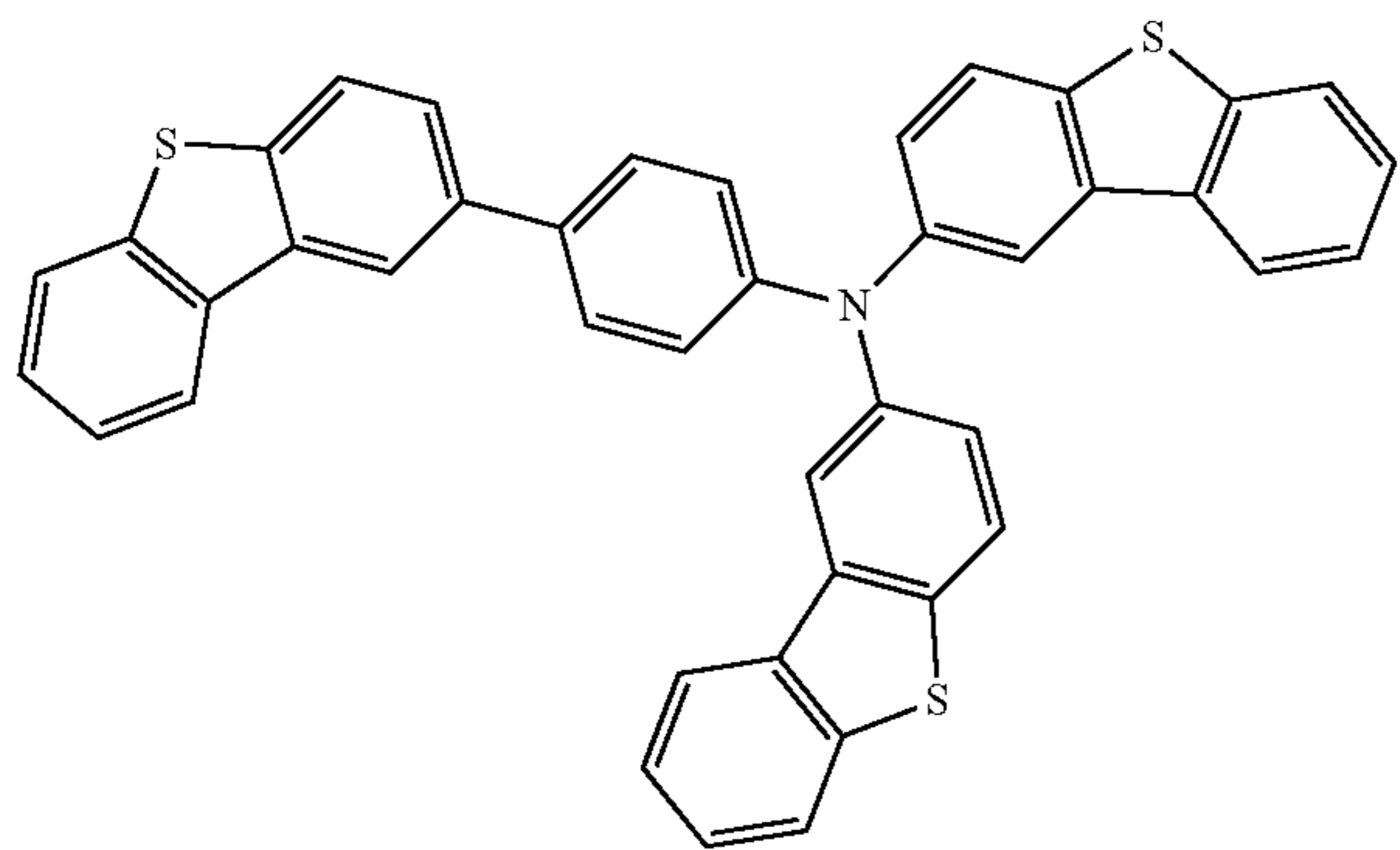
39

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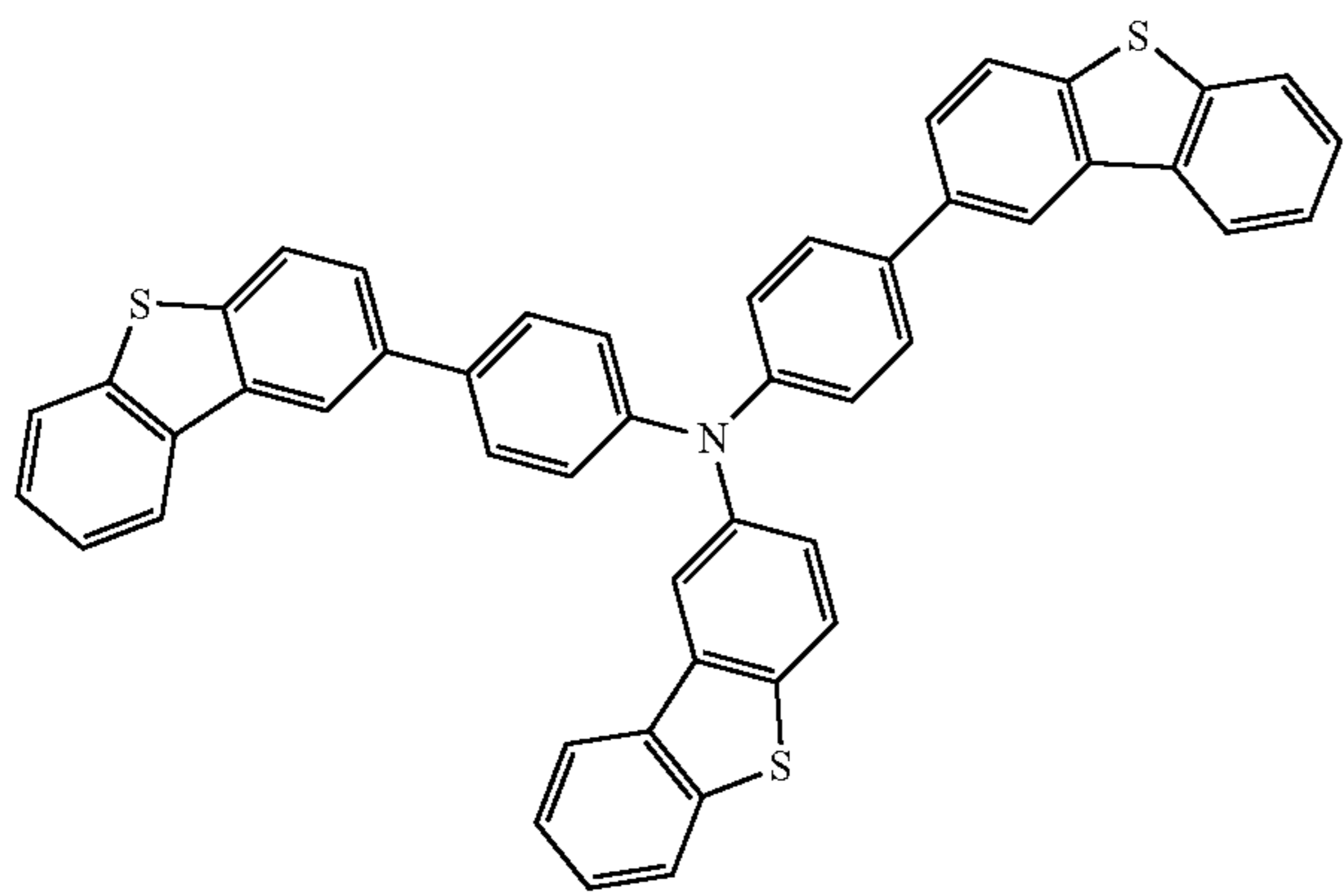
1-36'



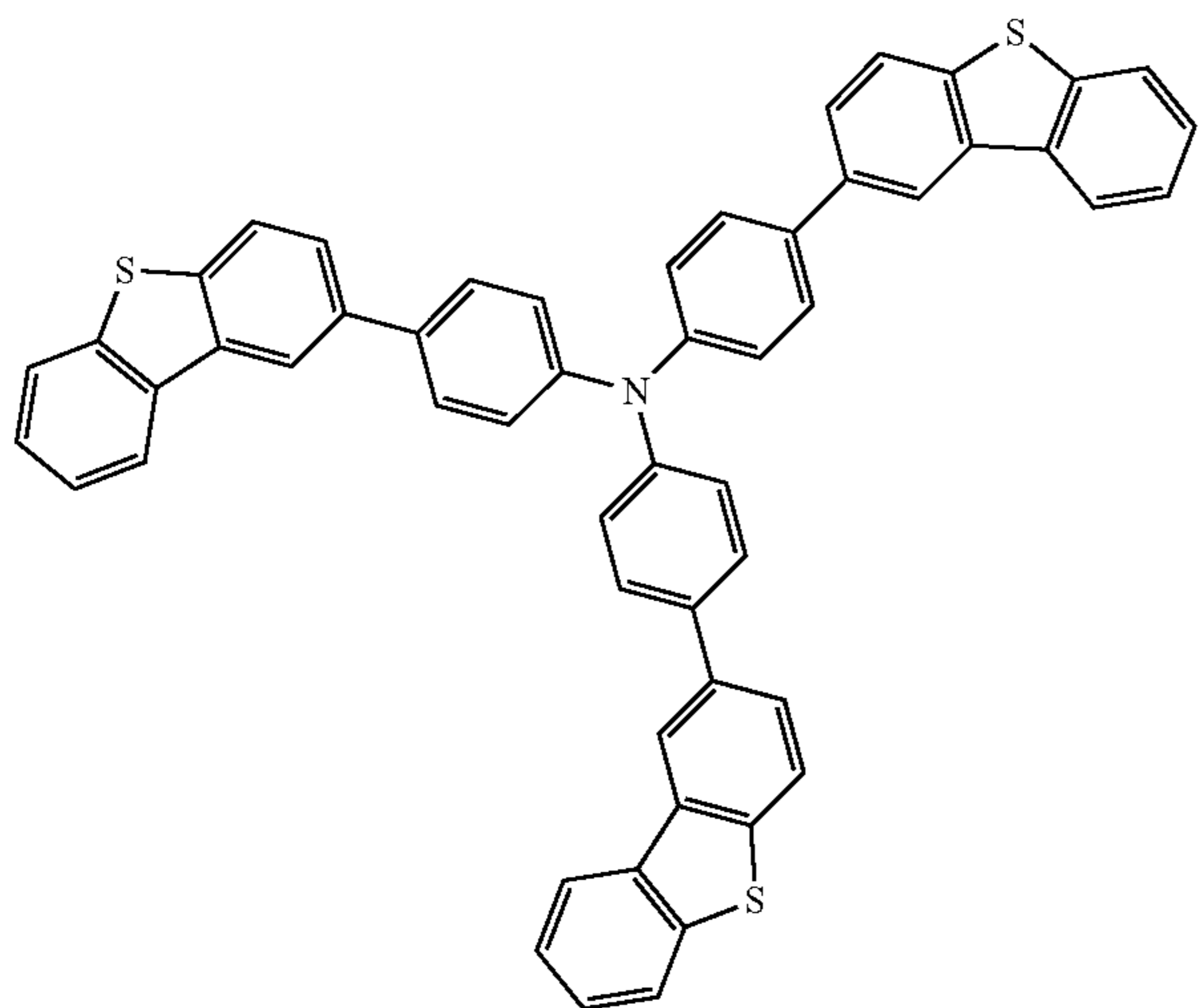
1-37'



1-38'



1-39'



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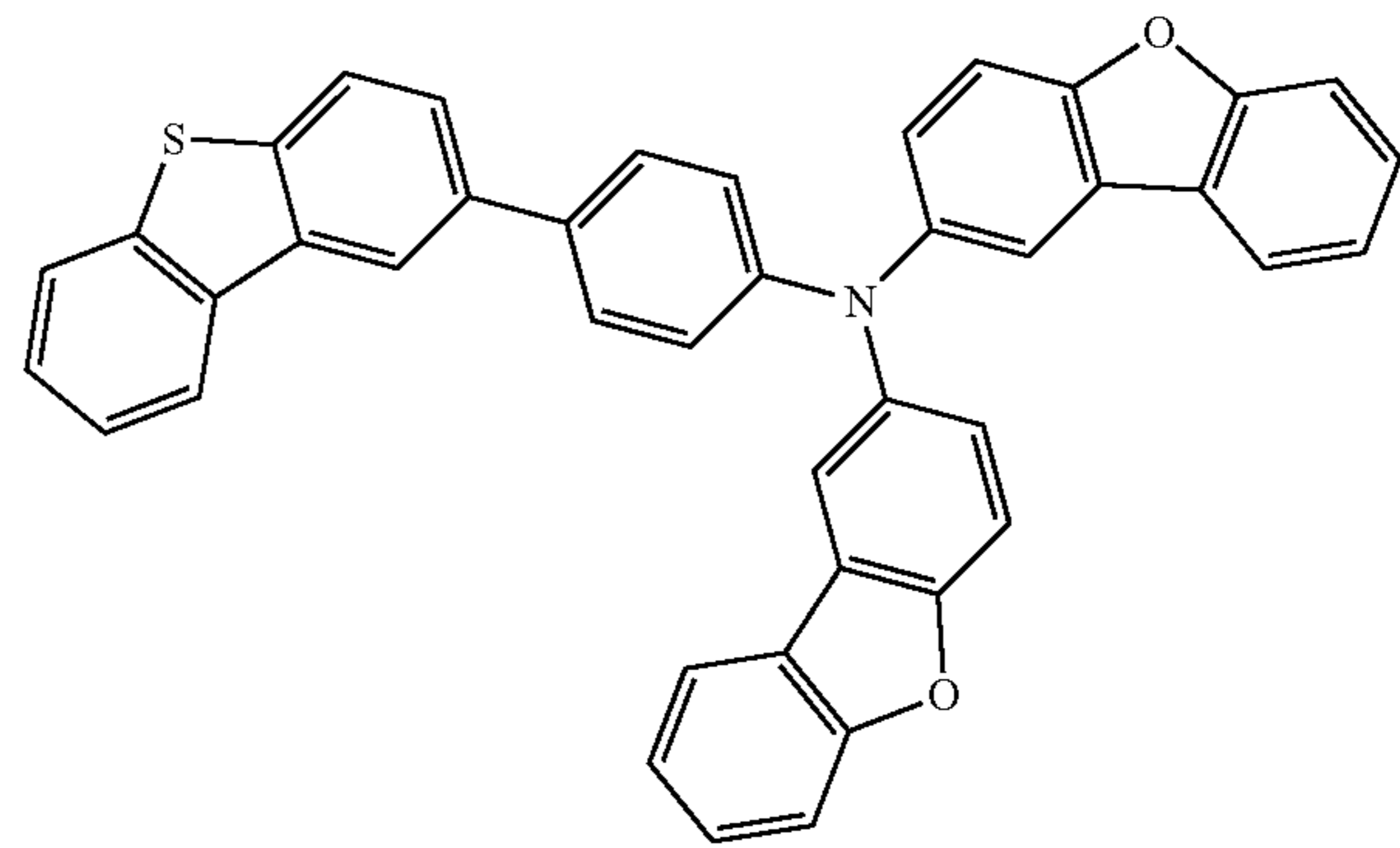
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1-40'

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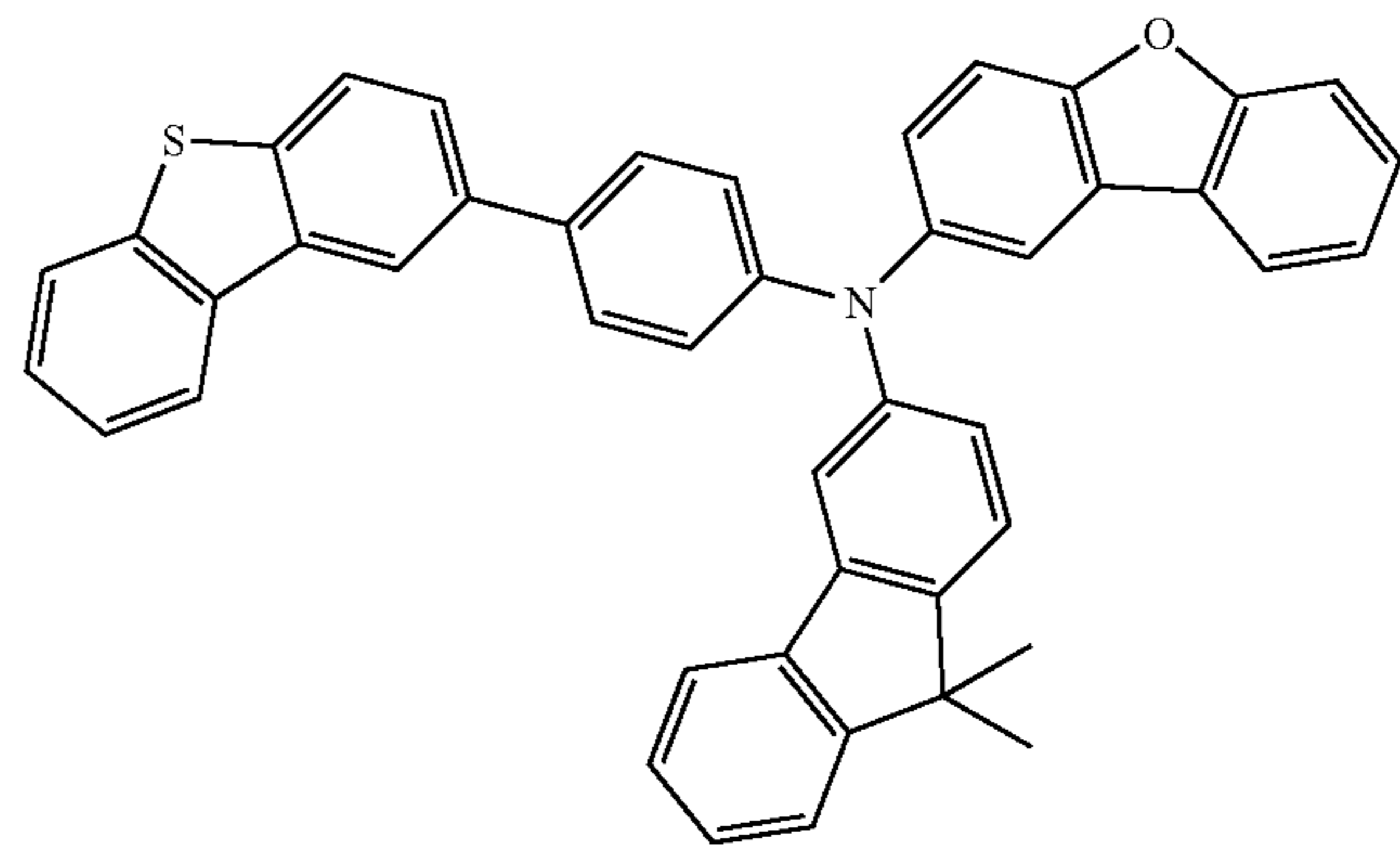
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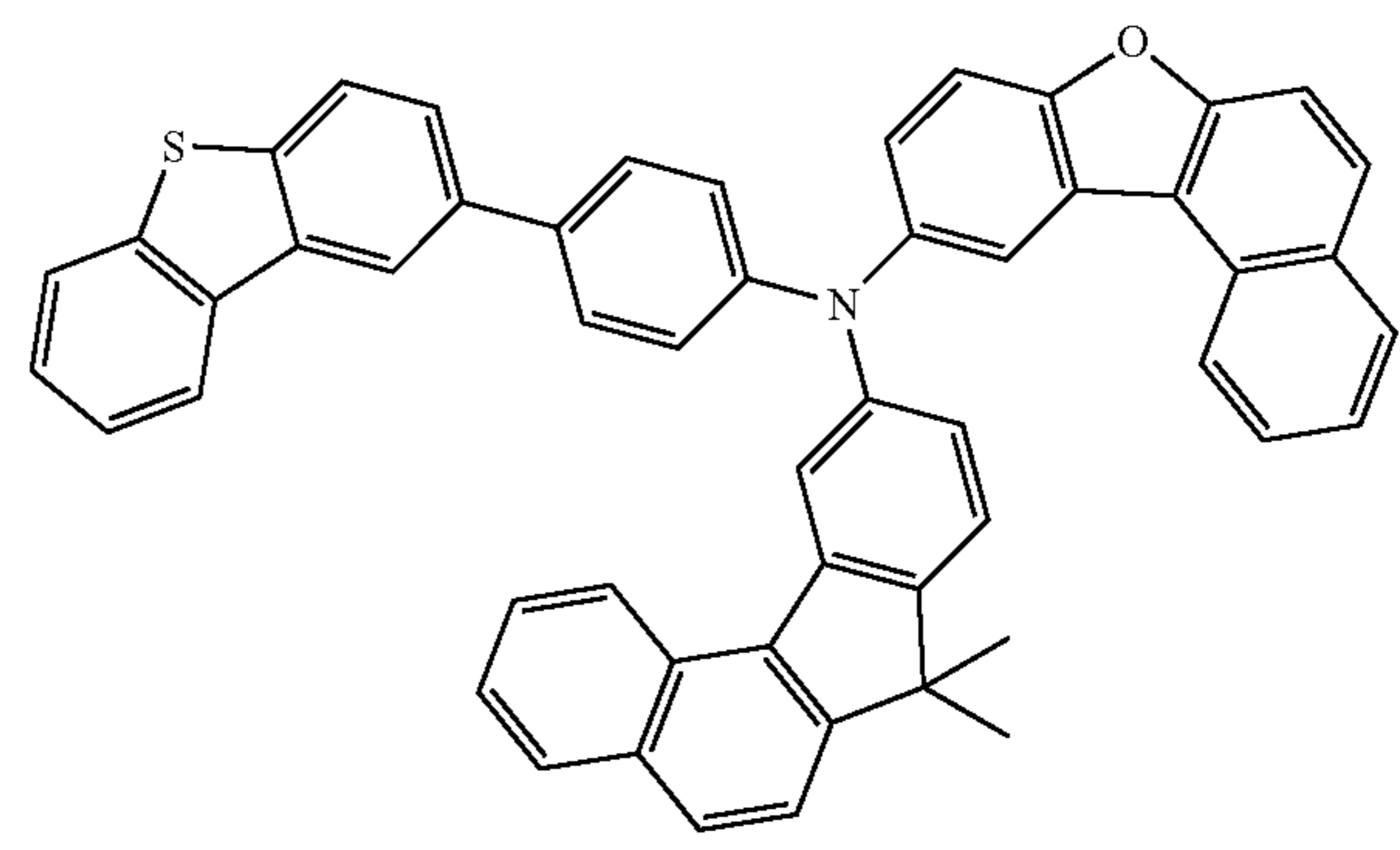
60

65

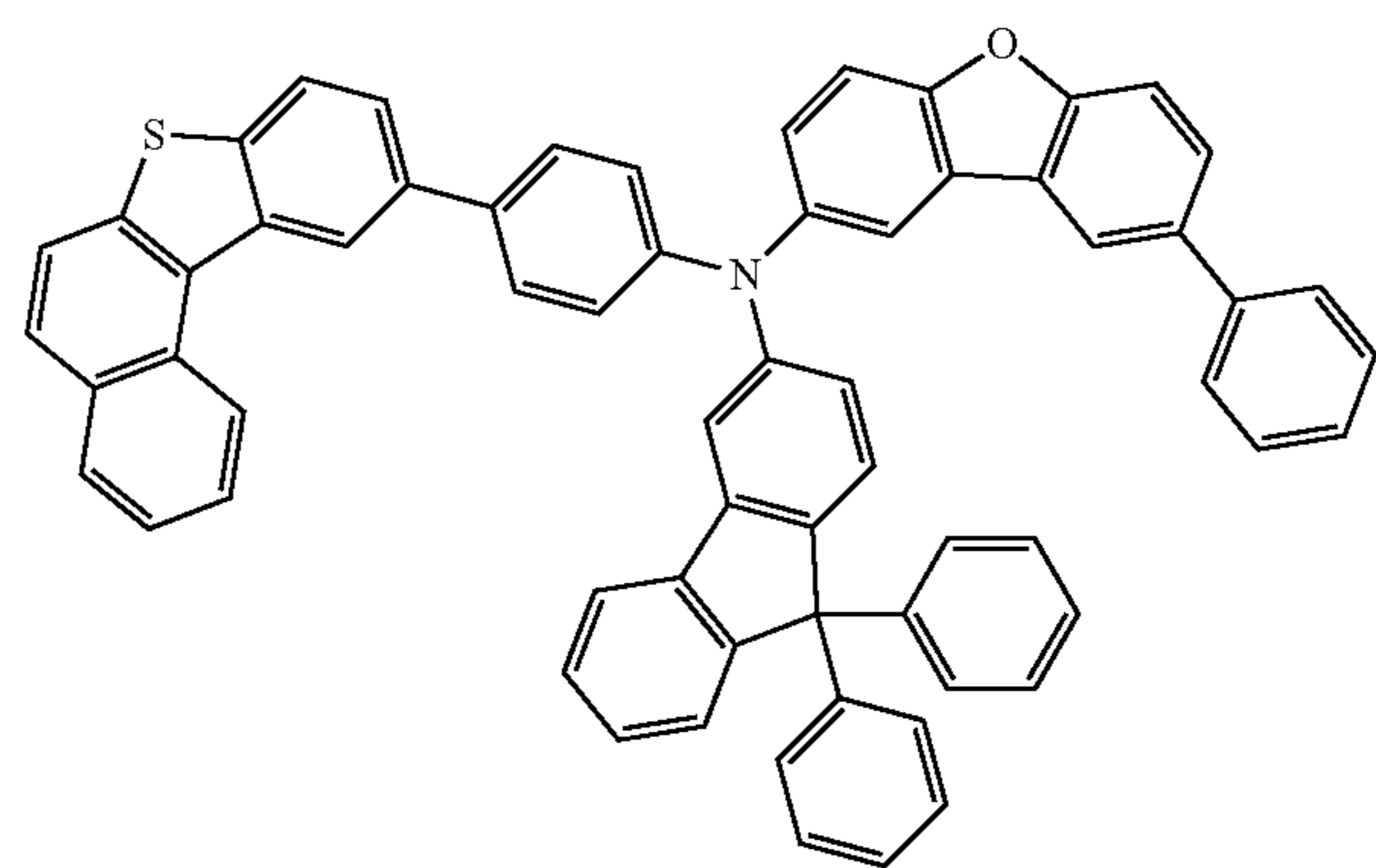


1-41'

1-42'

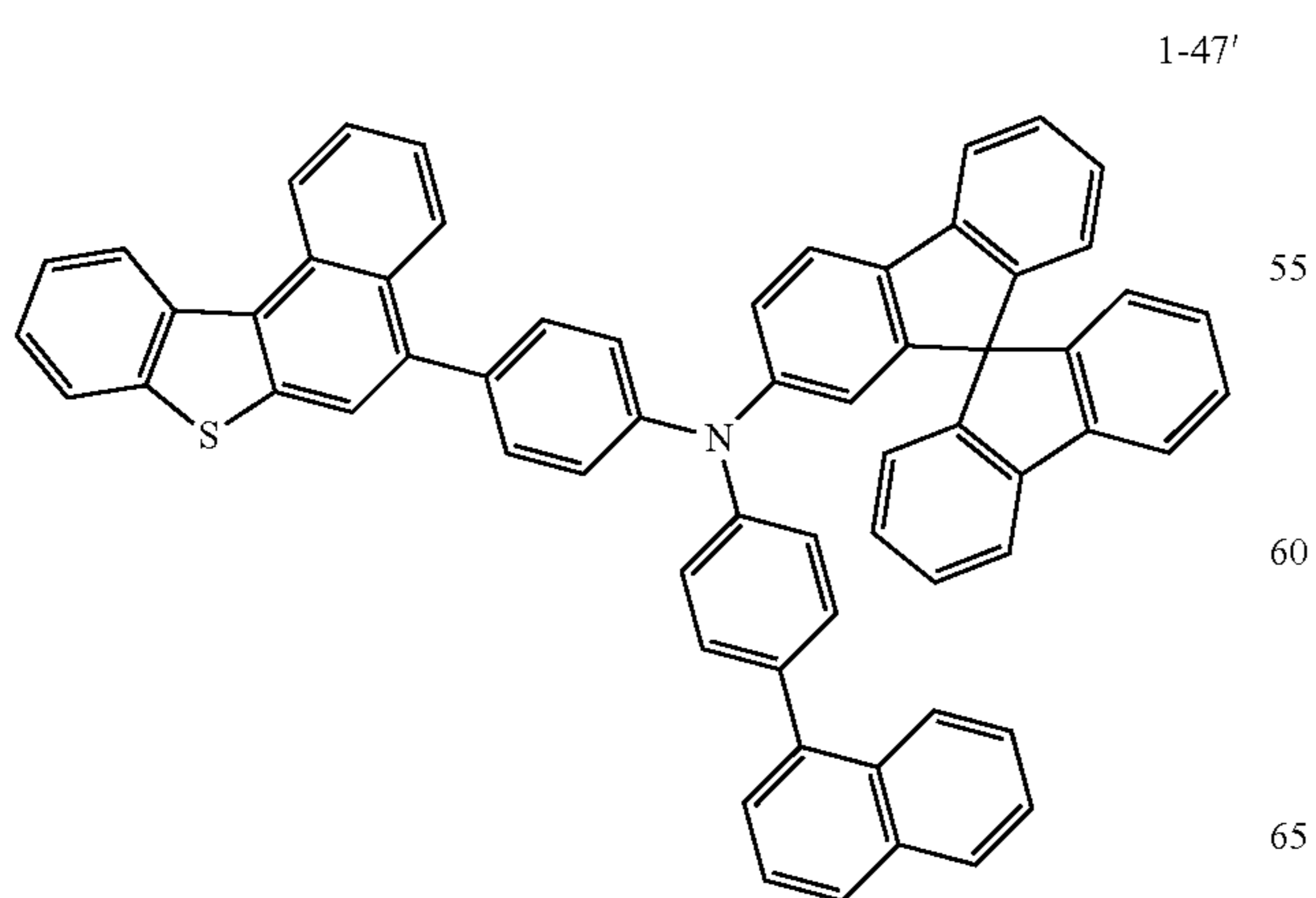
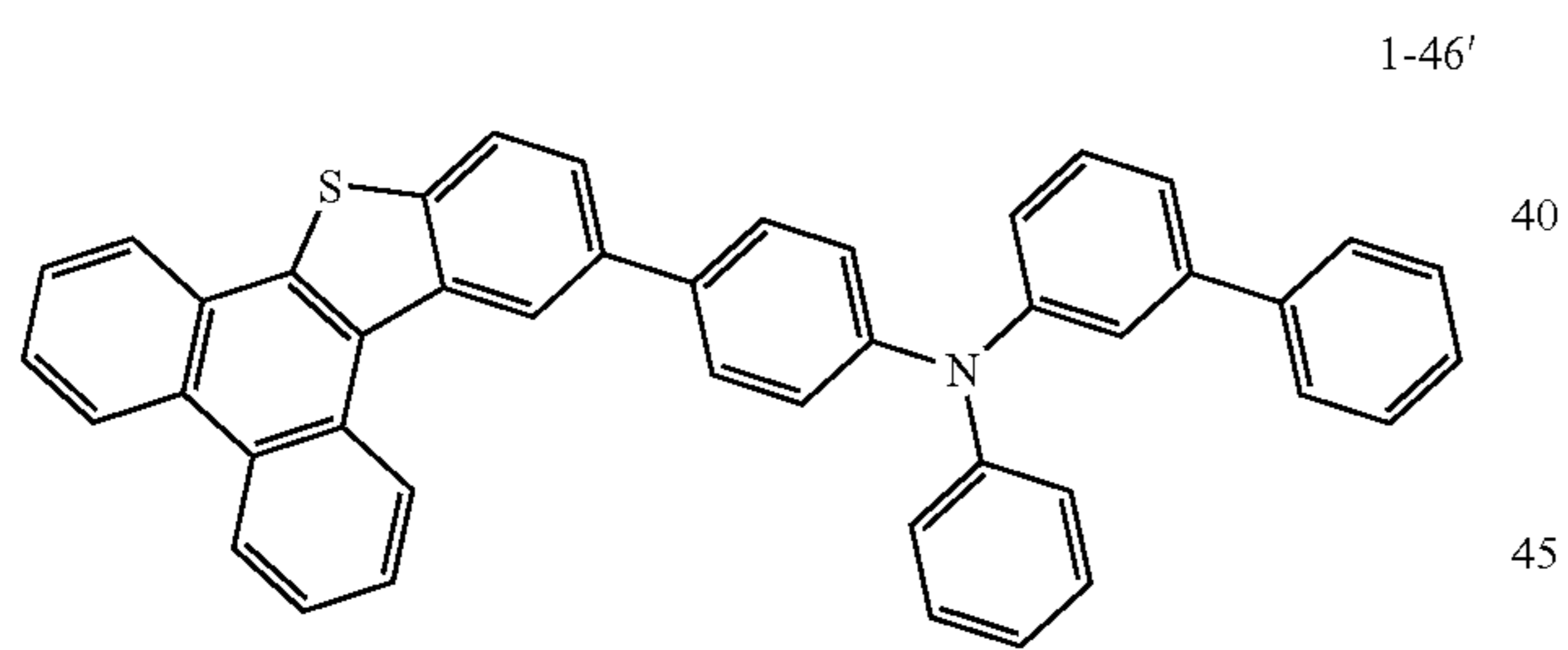
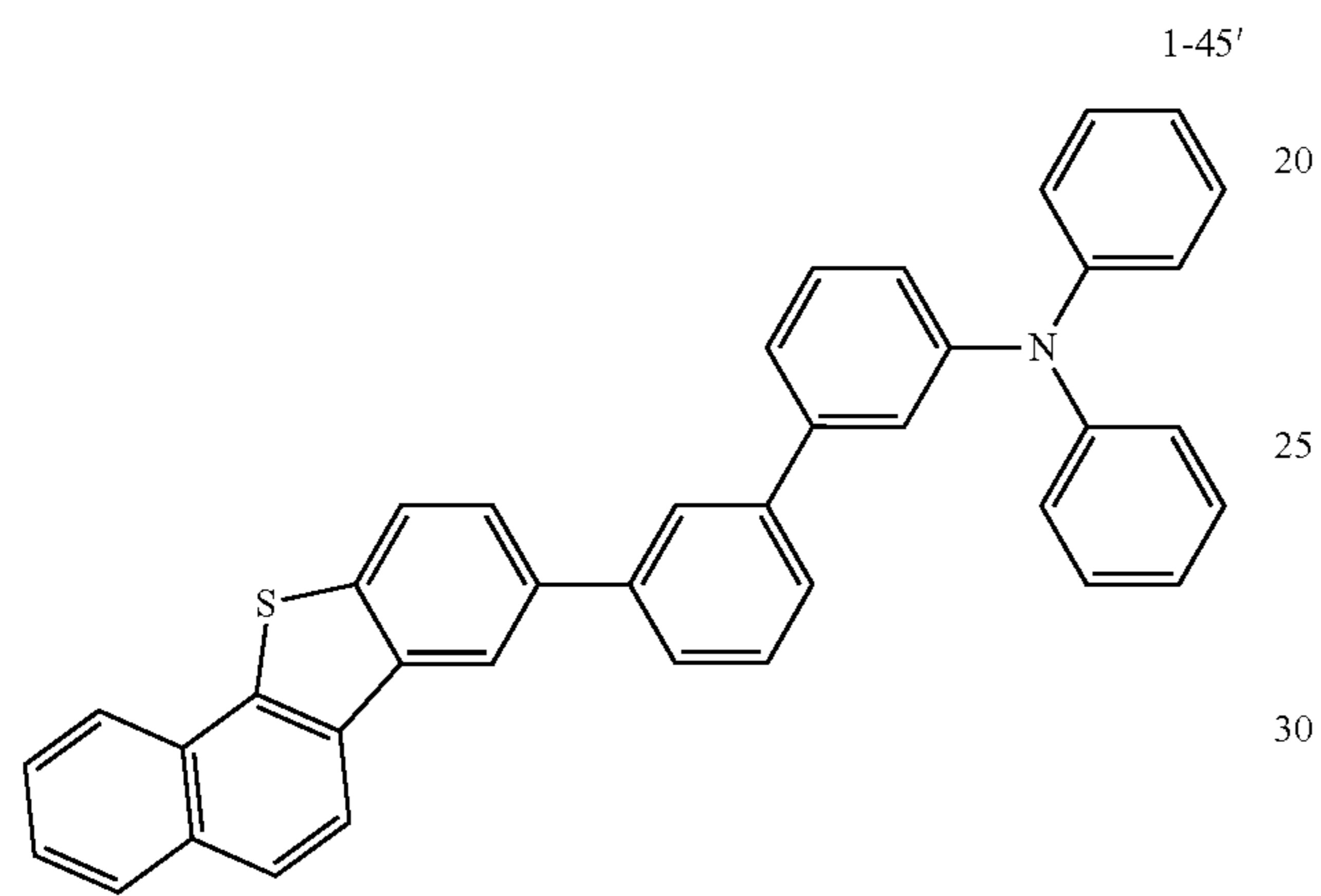
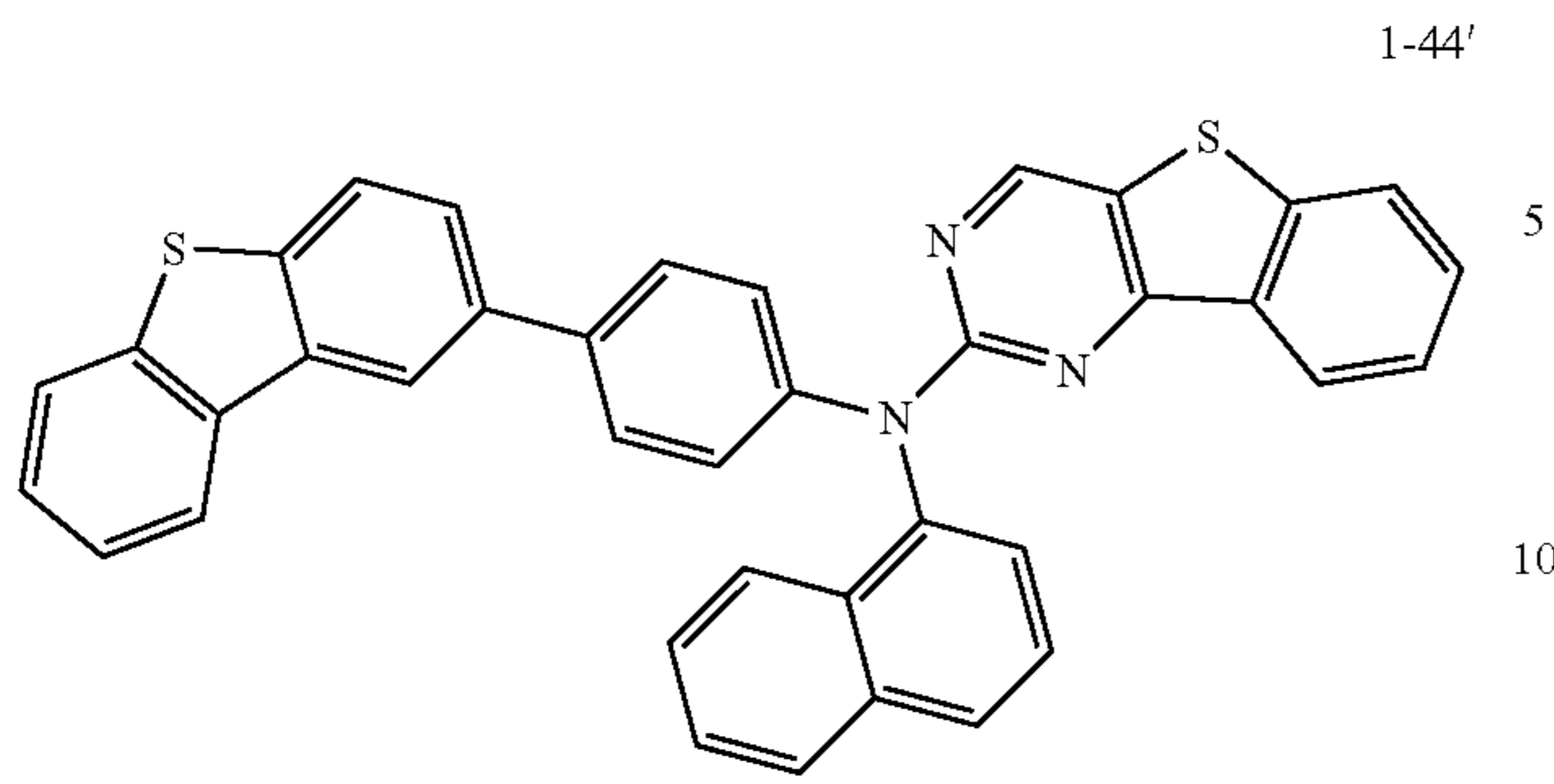


1-43'



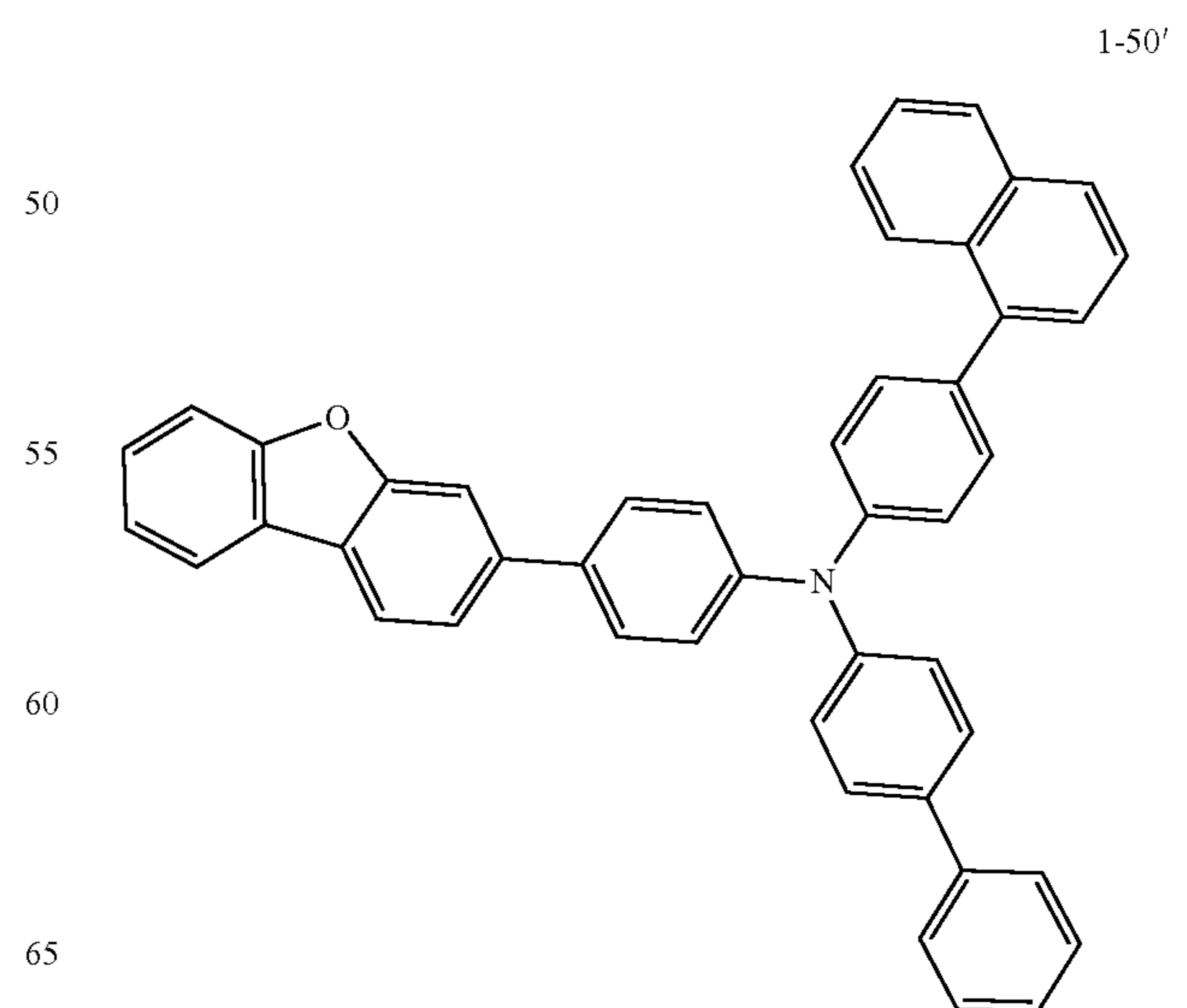
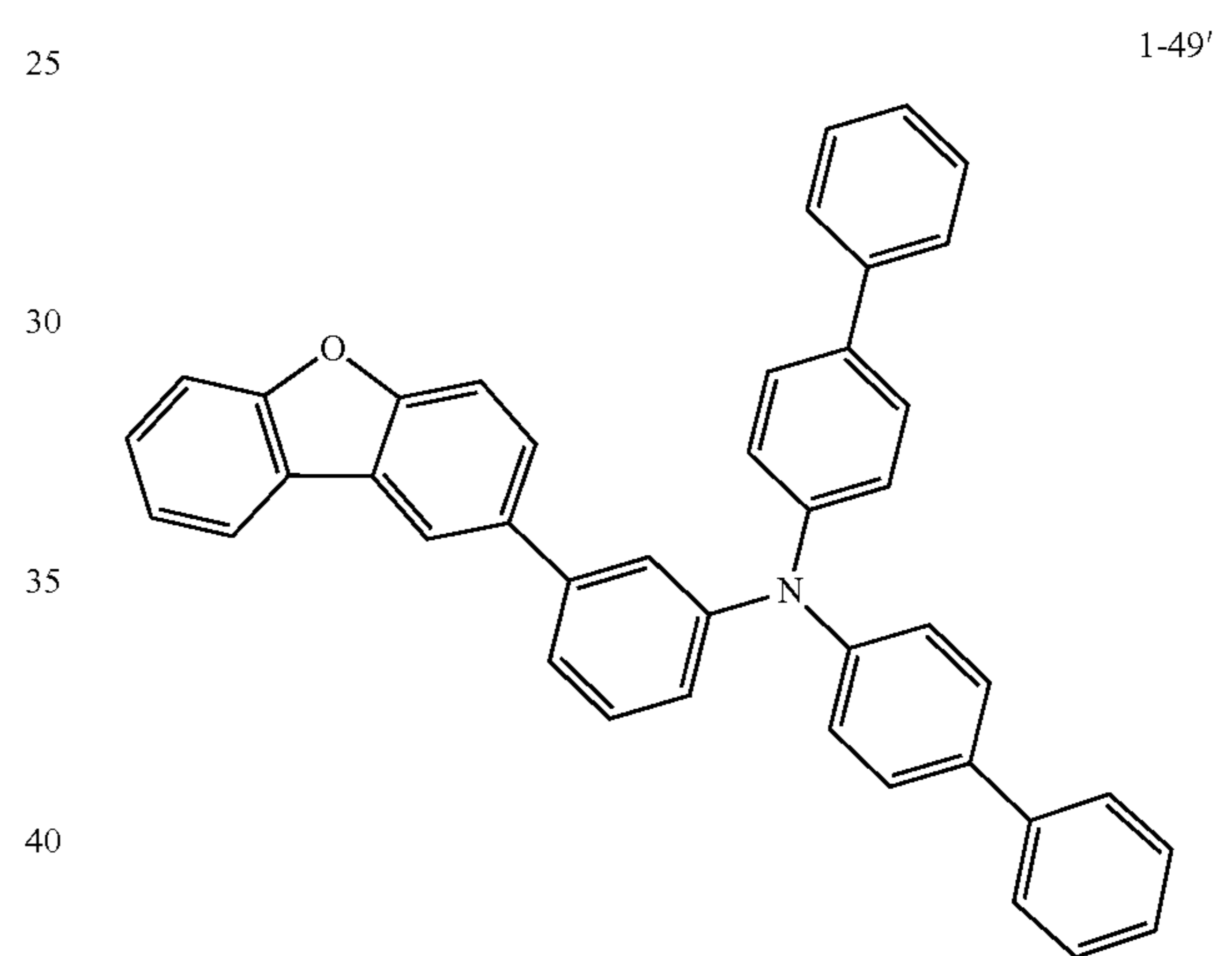
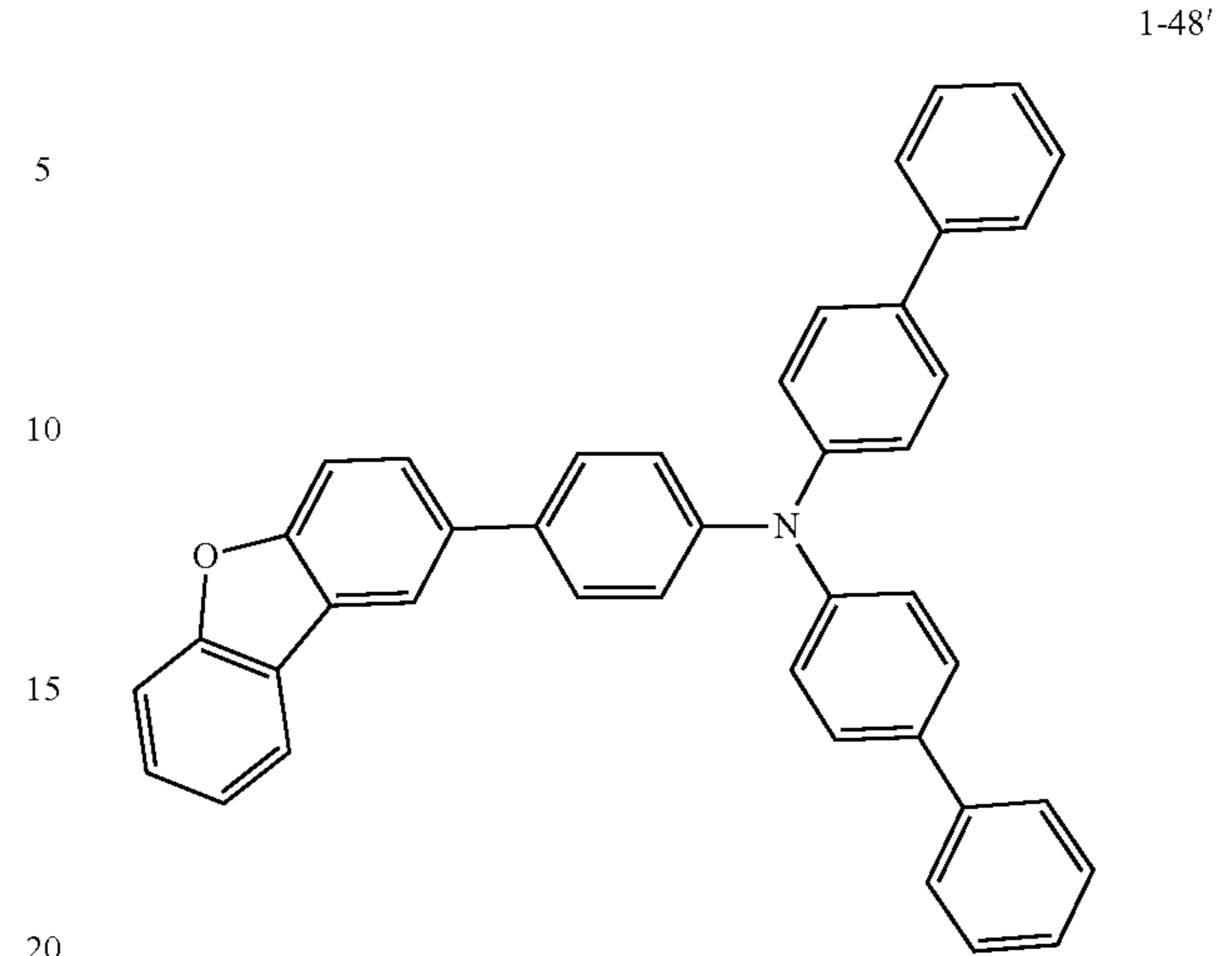
41

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42

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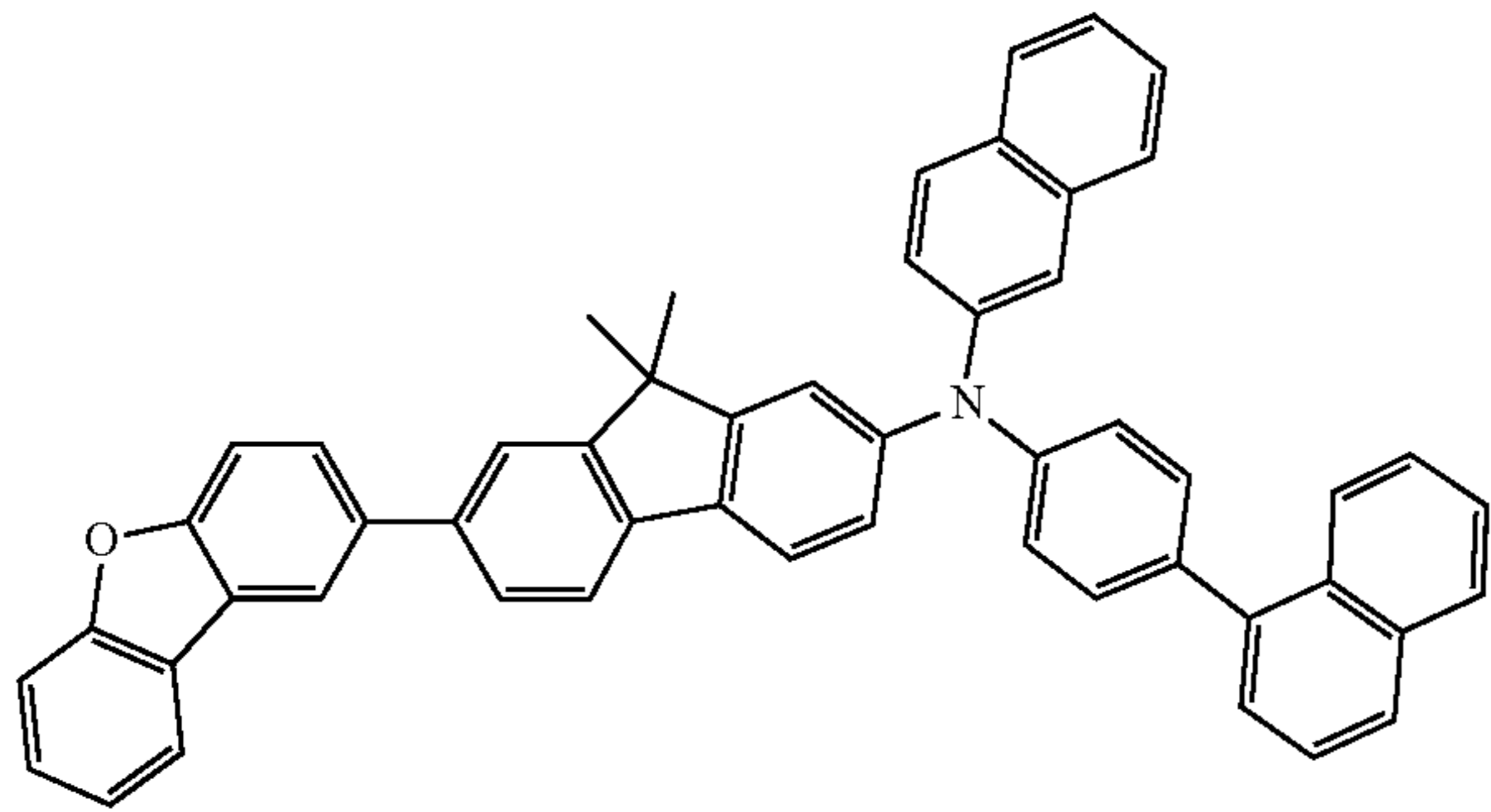




43

-continued

1-51'



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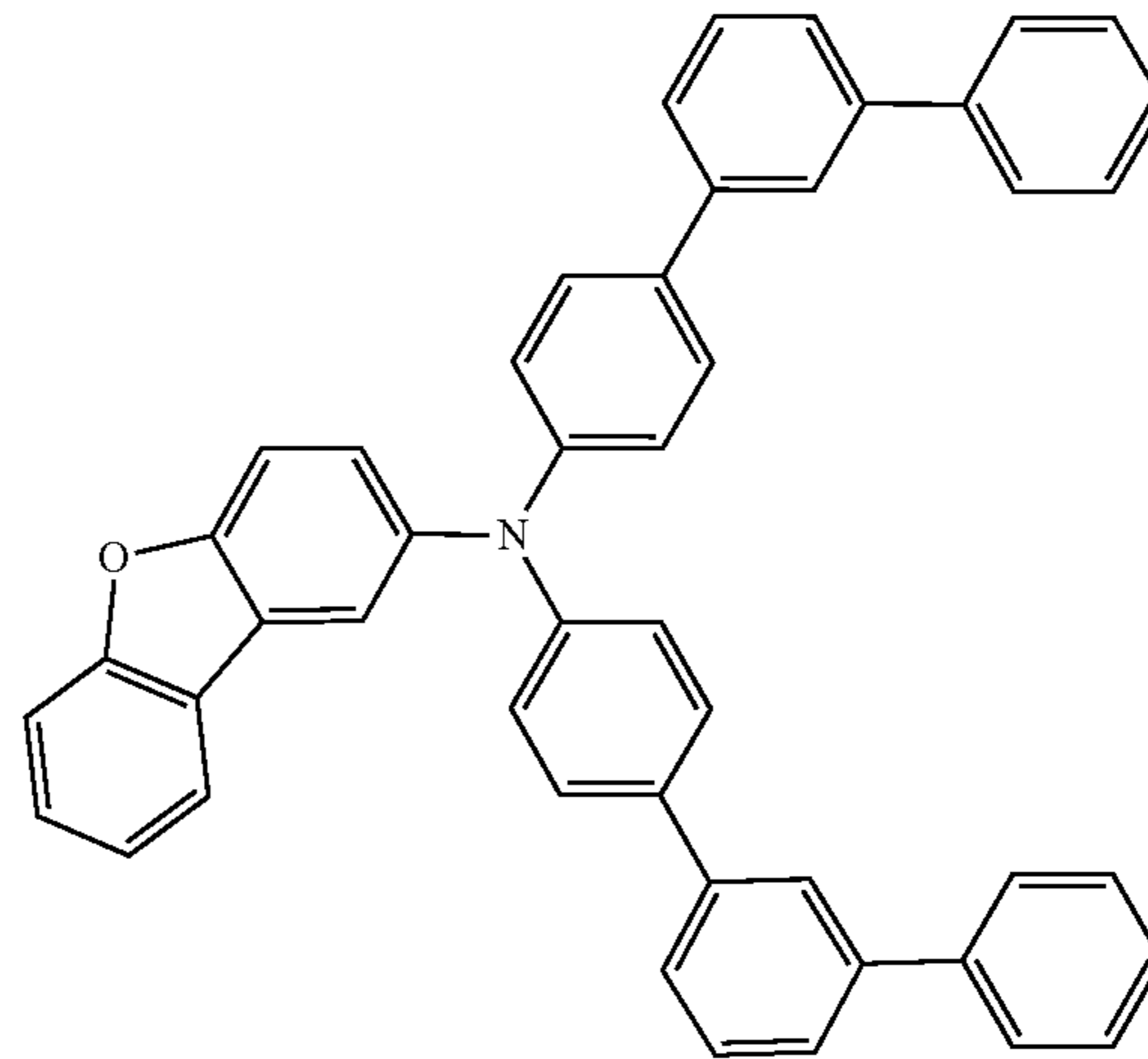
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44

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1-54'



1-52'

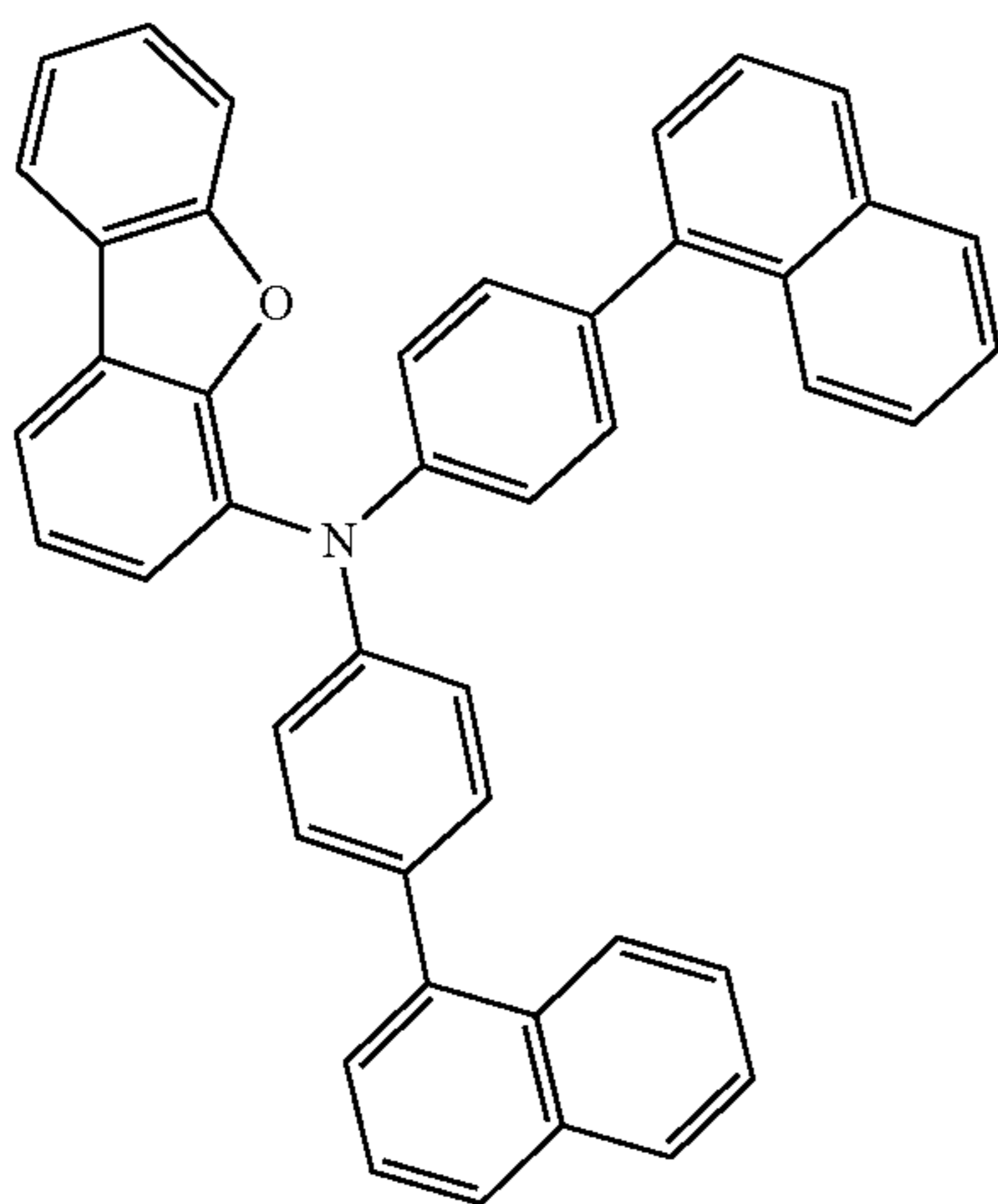
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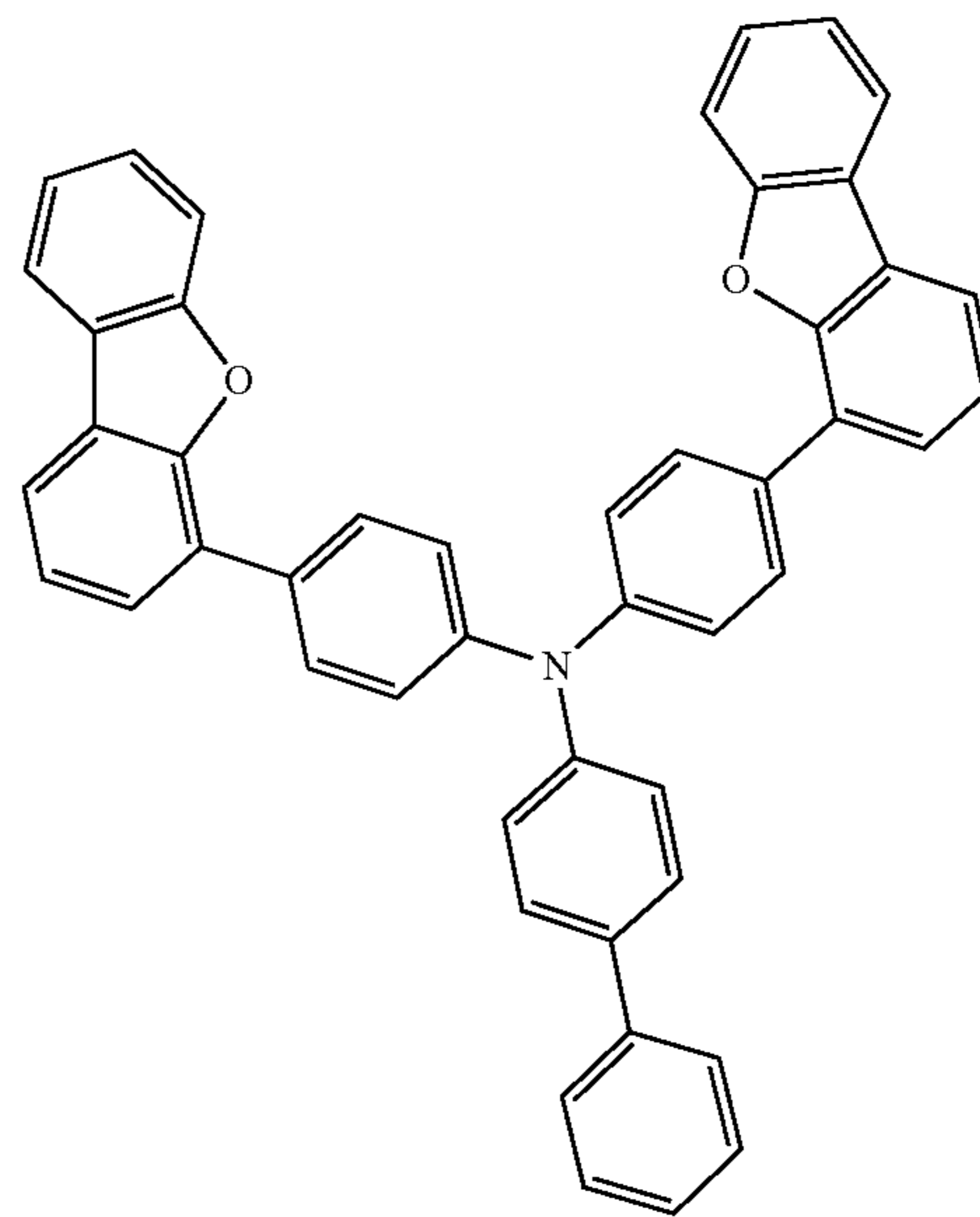
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1-55'



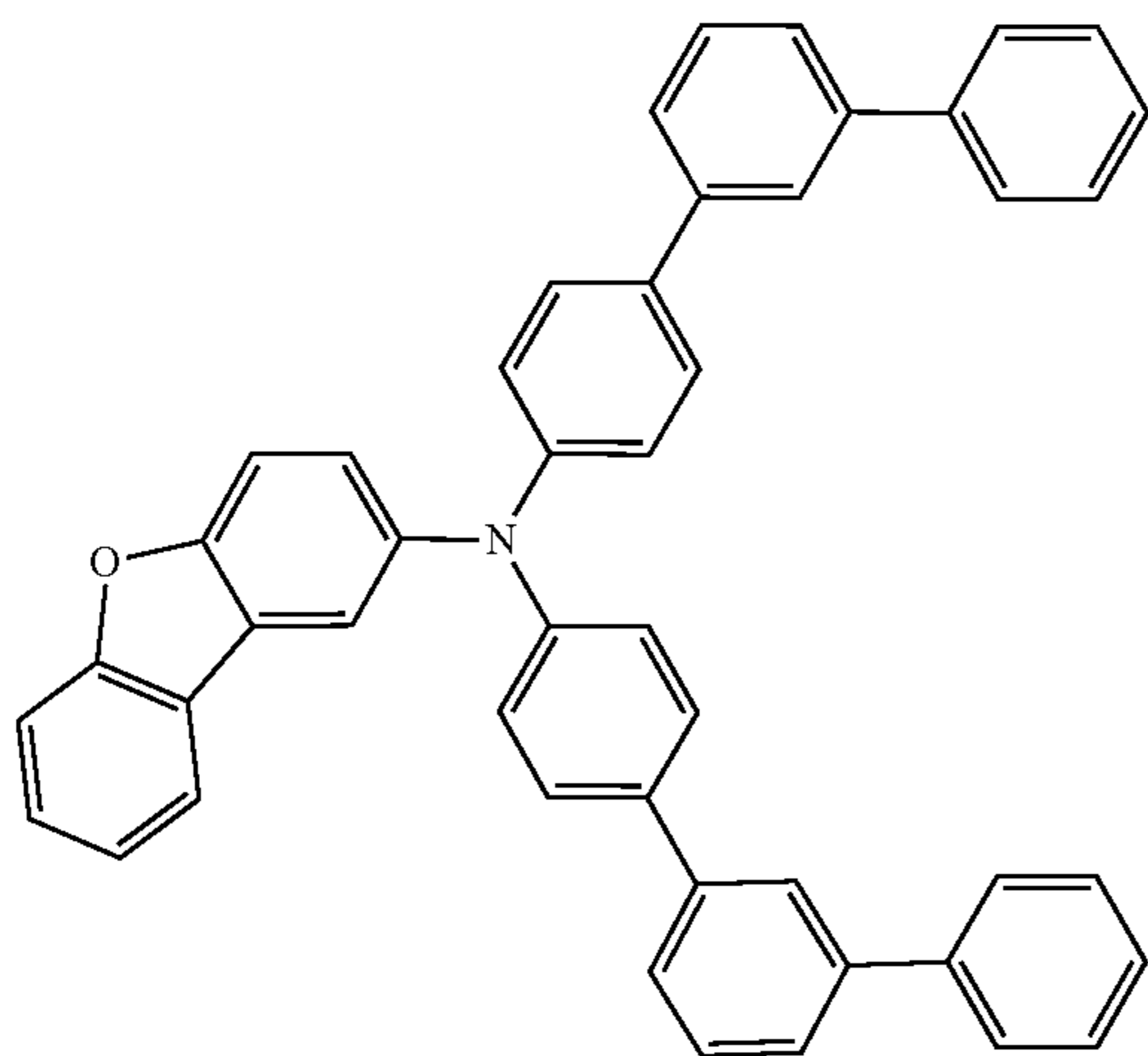
1-53'

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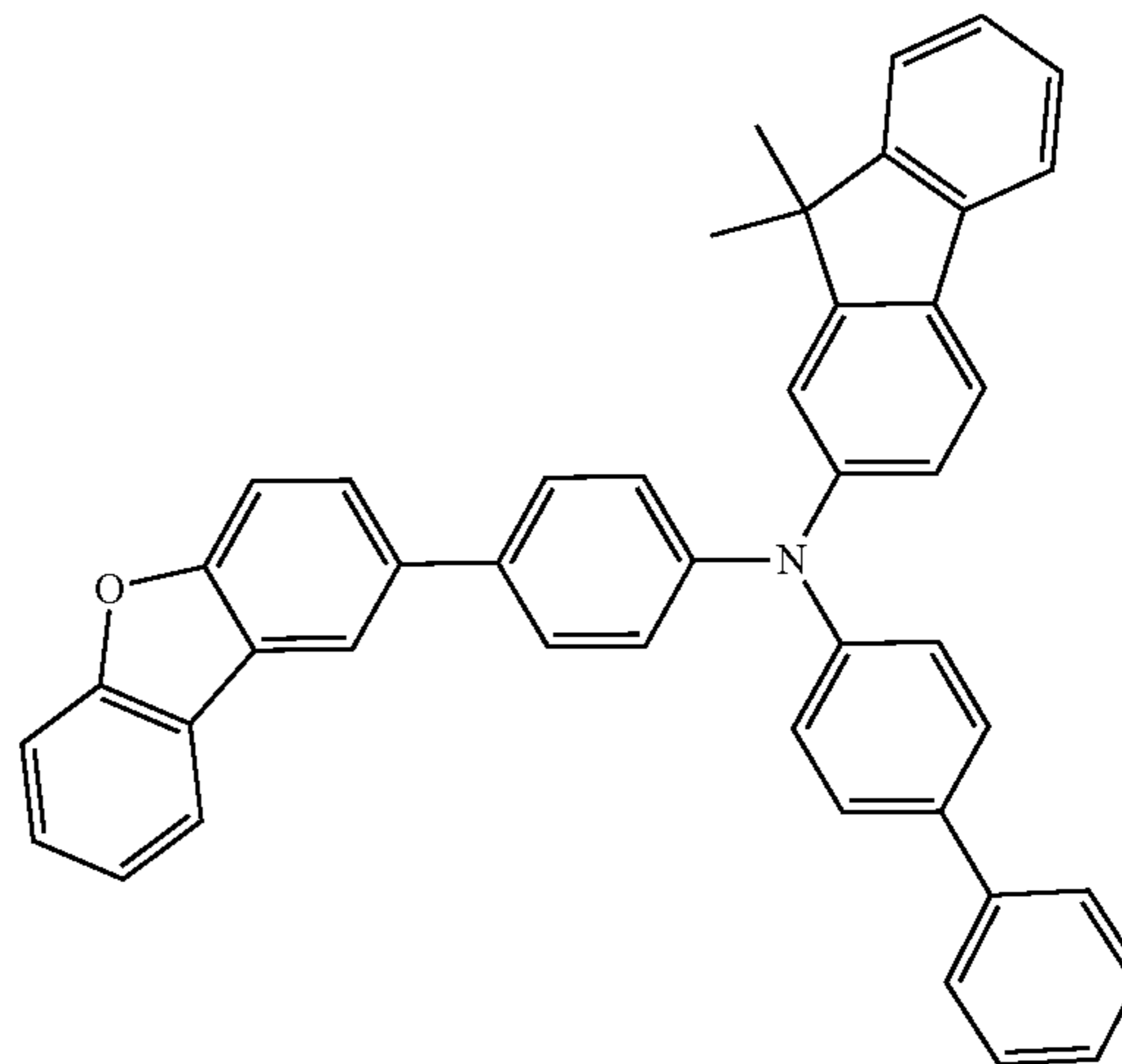
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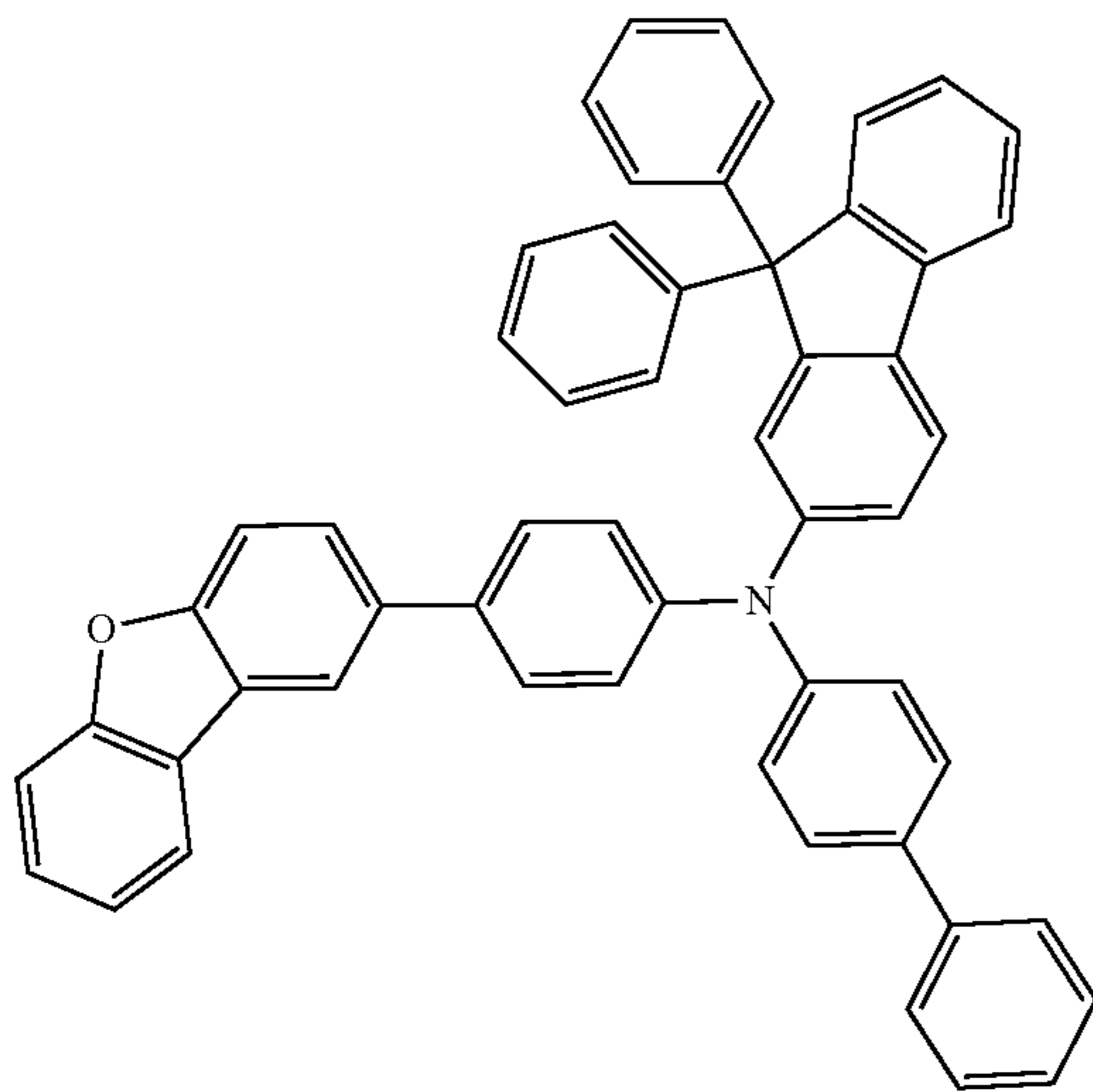


1-56'



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1-57'

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1-58'

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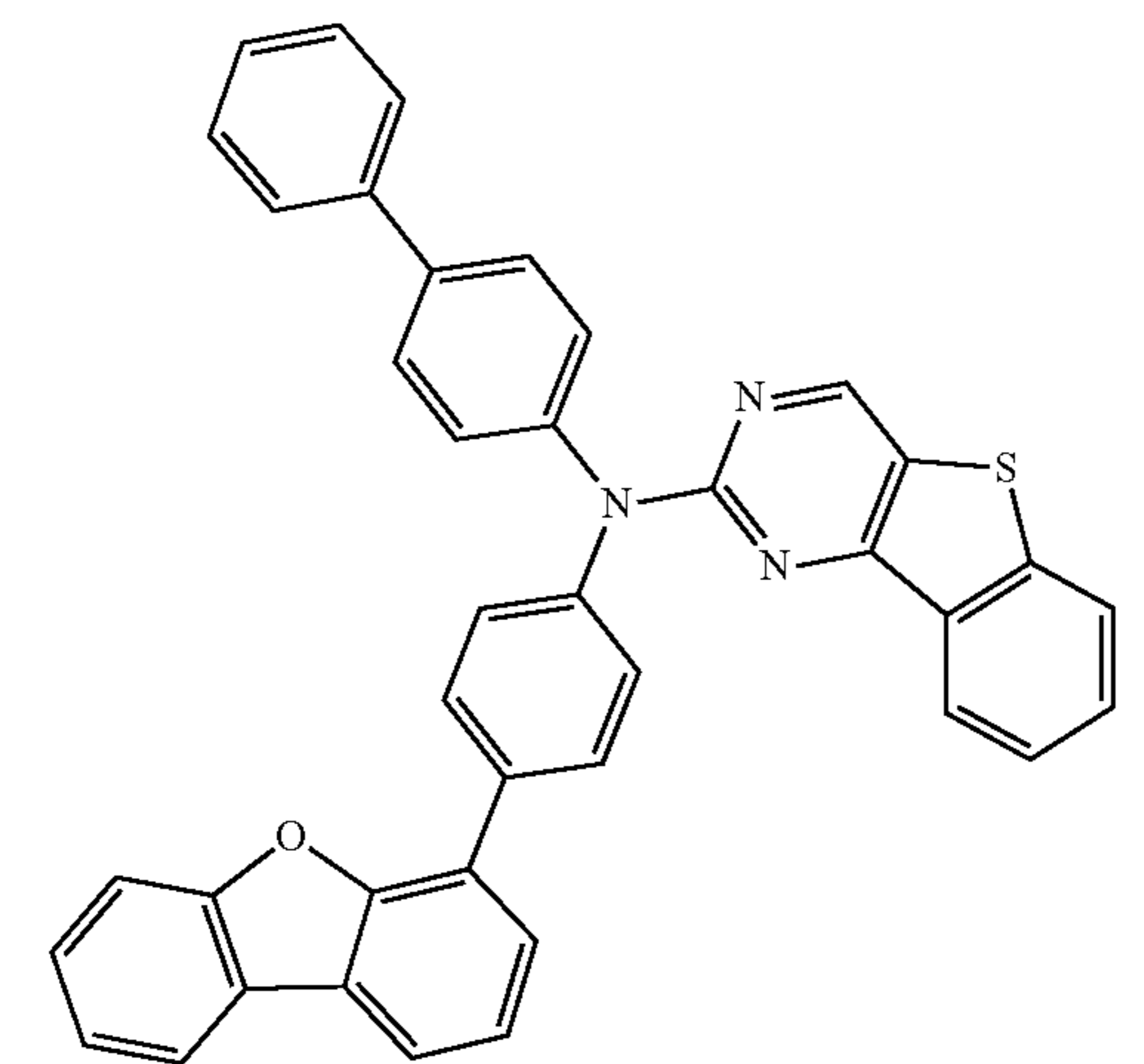
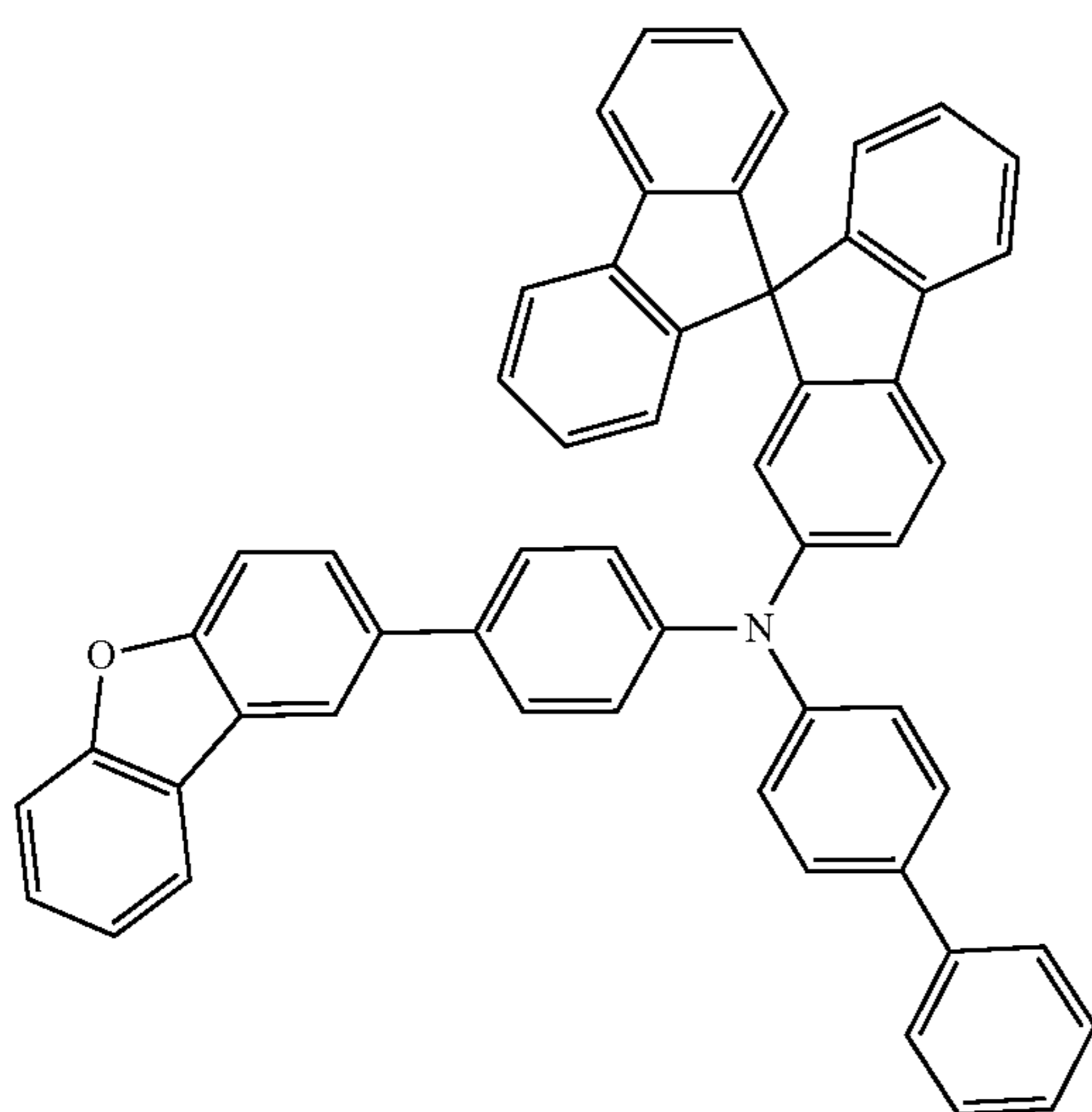
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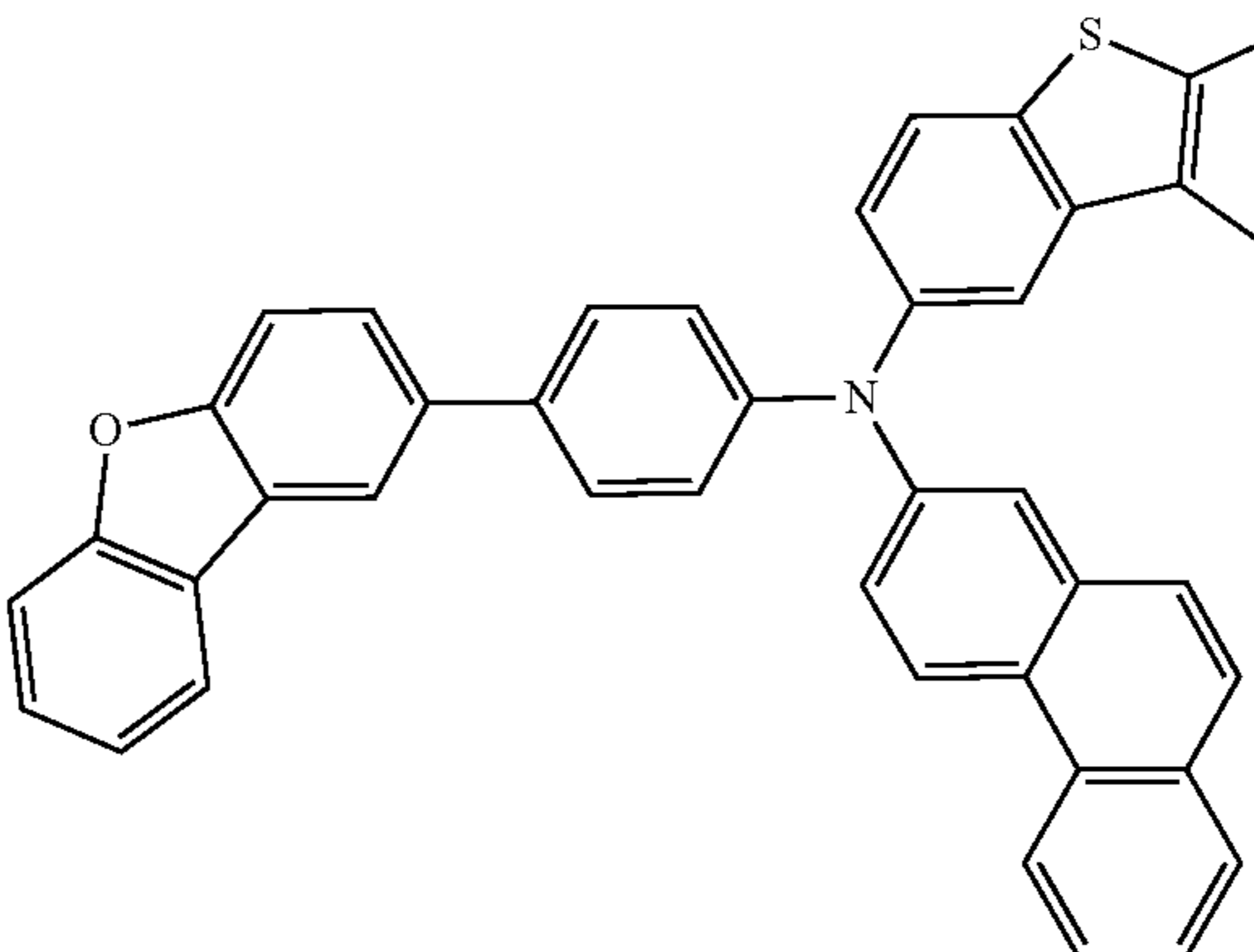
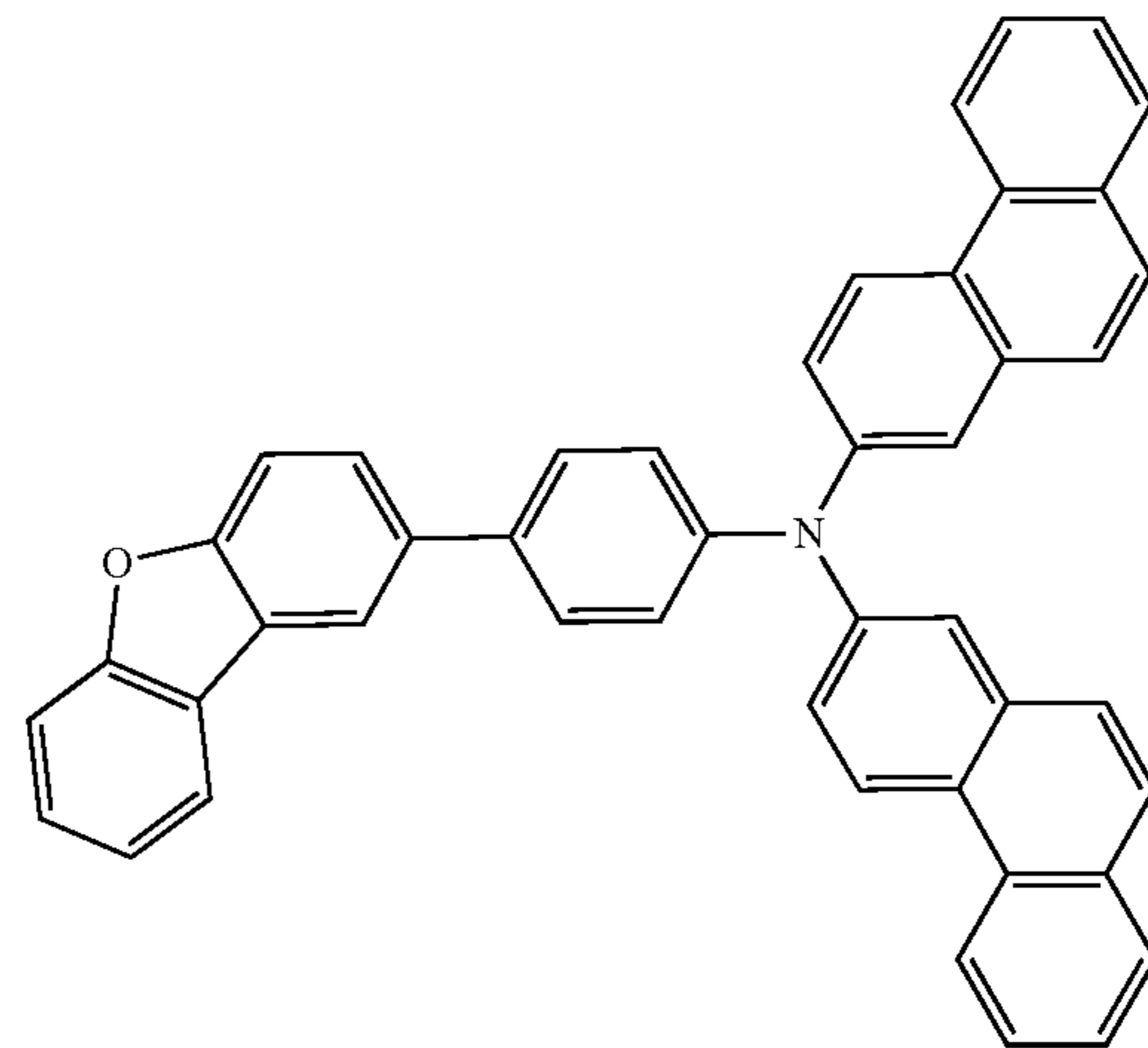
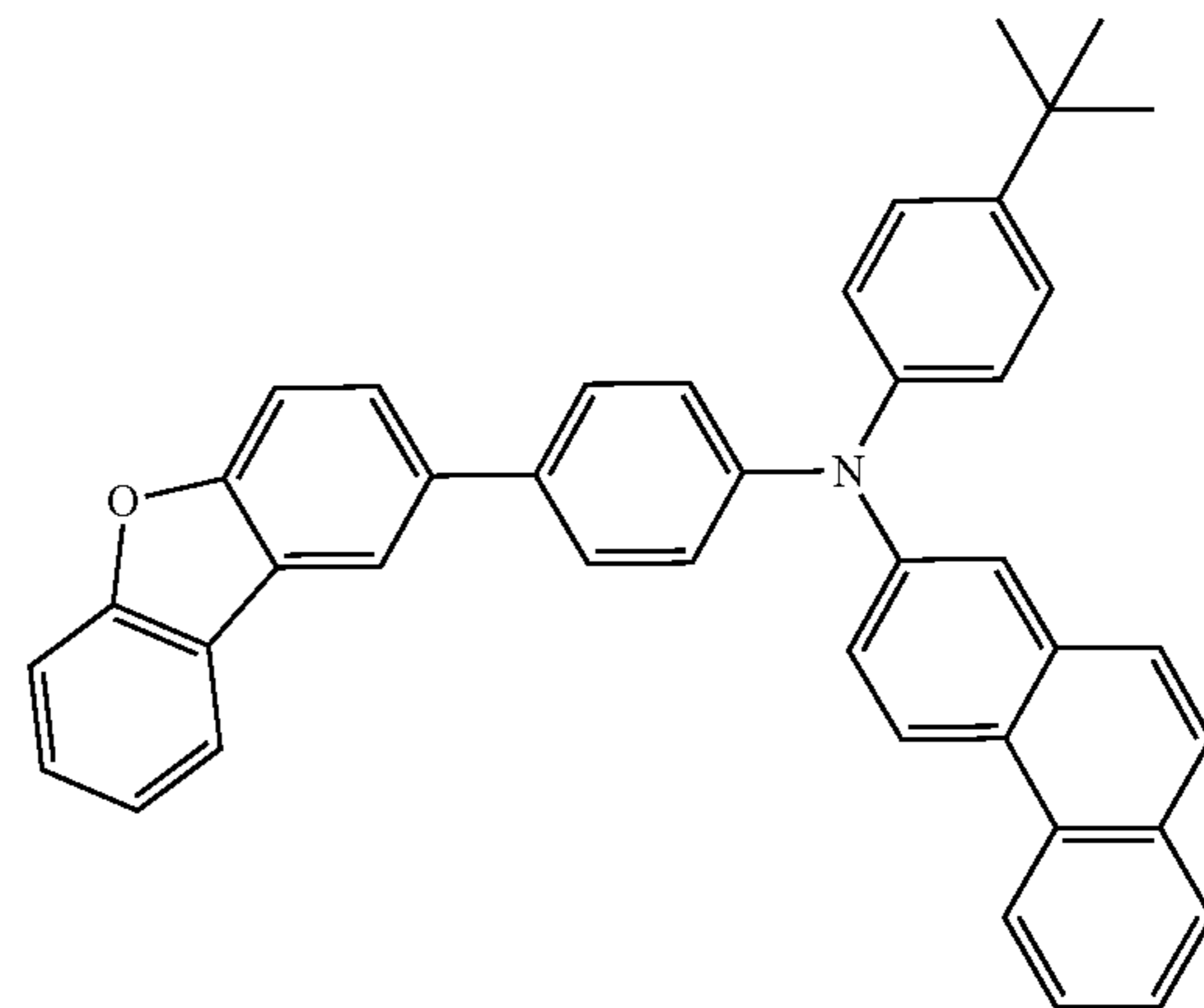
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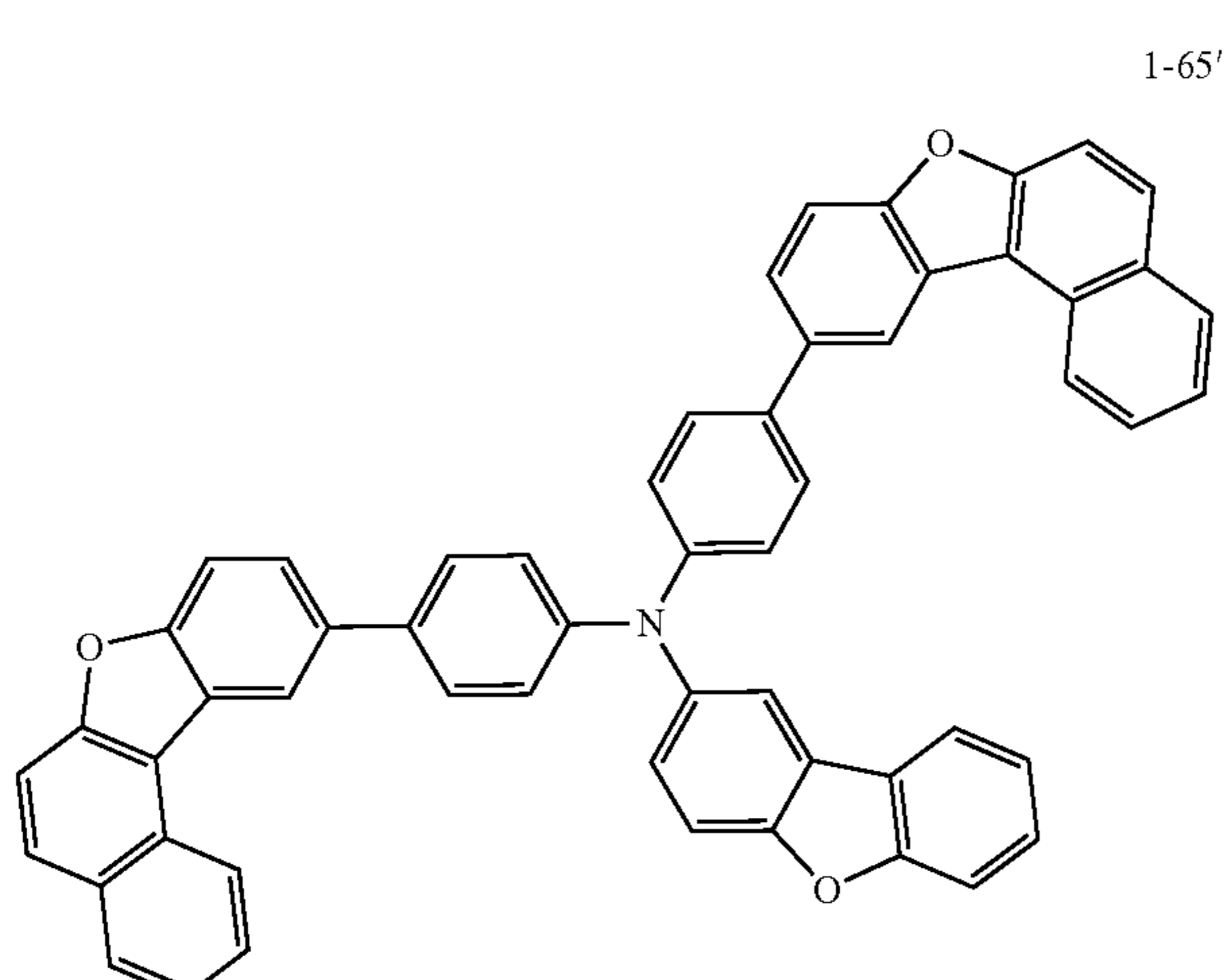
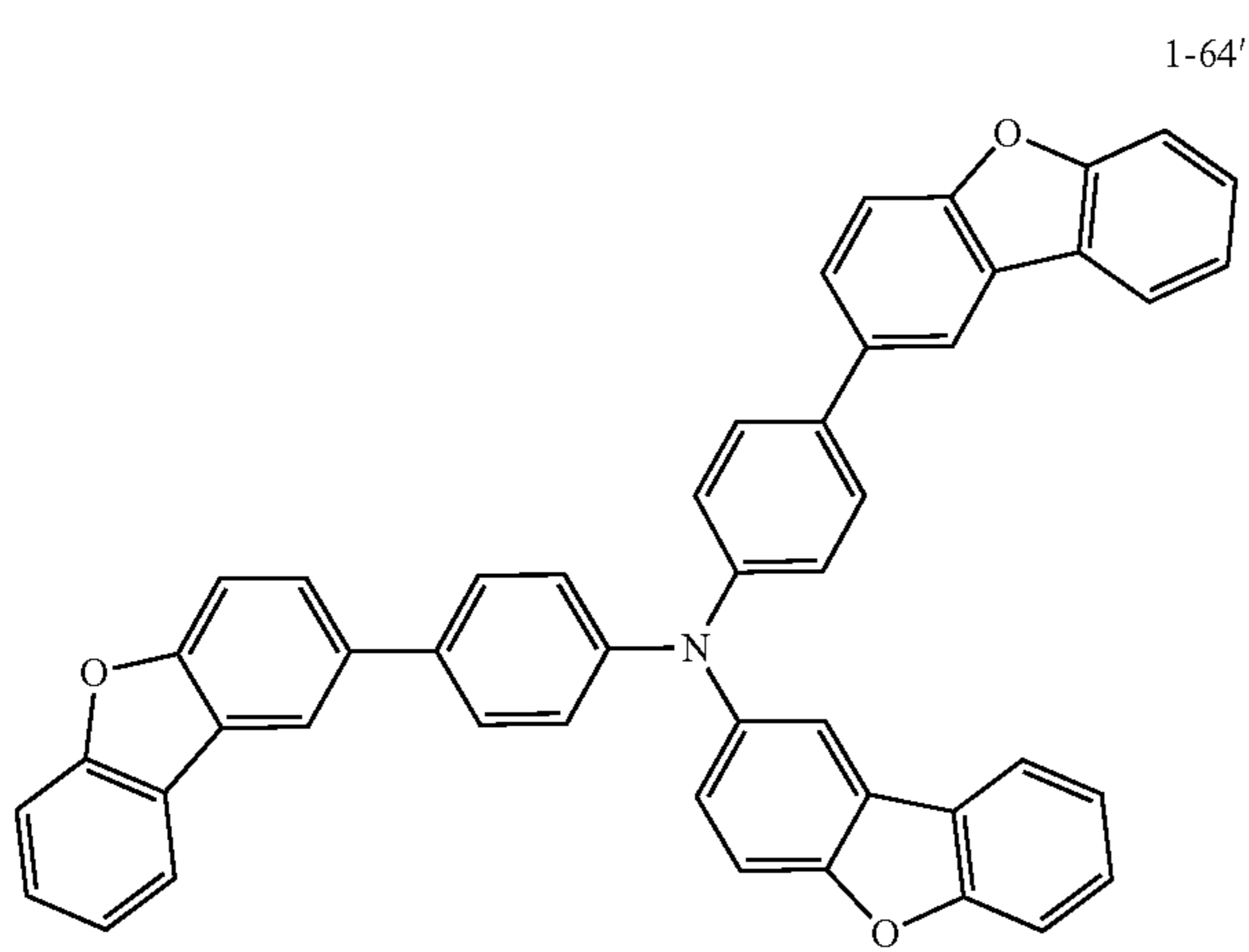
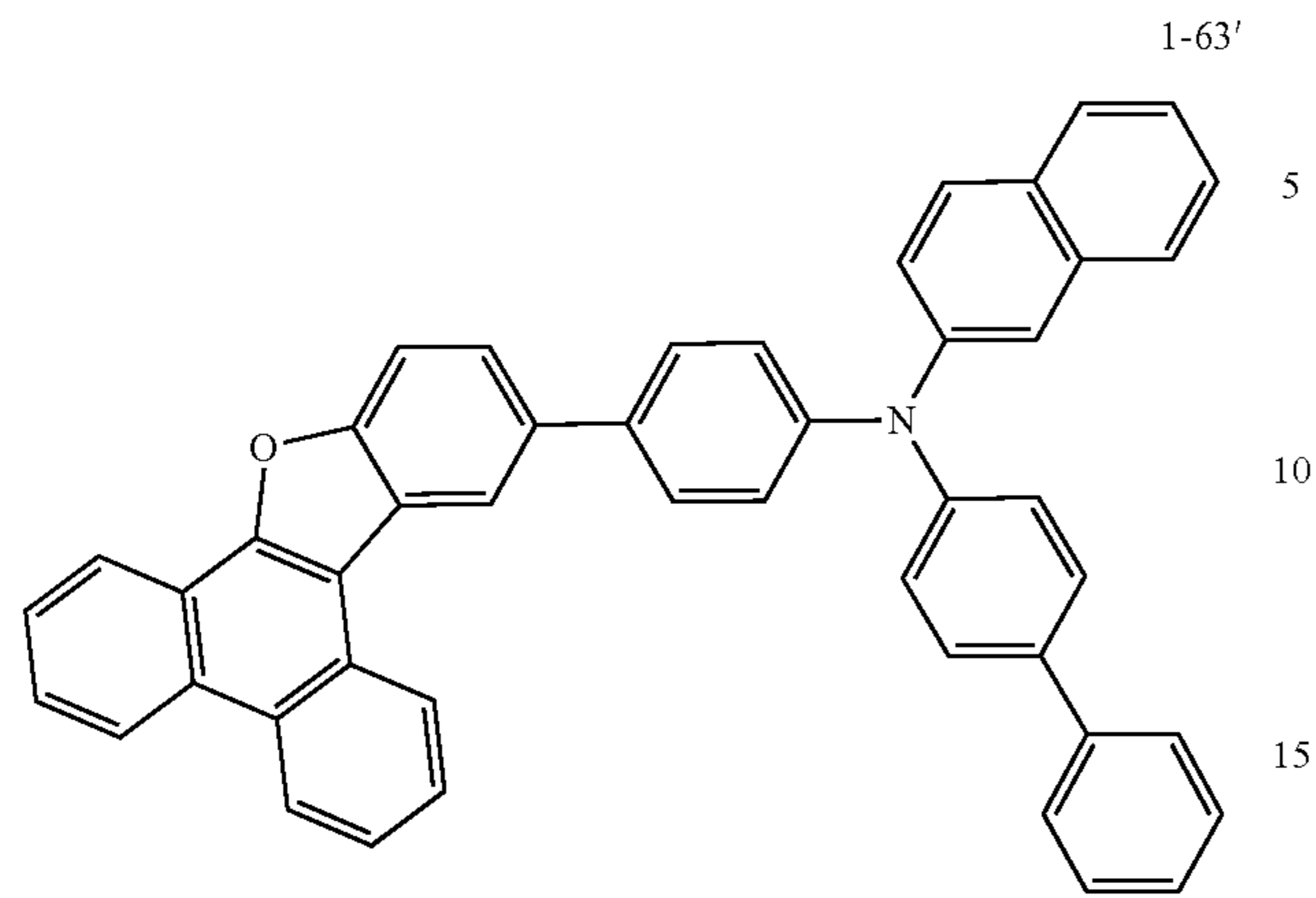


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1-62'

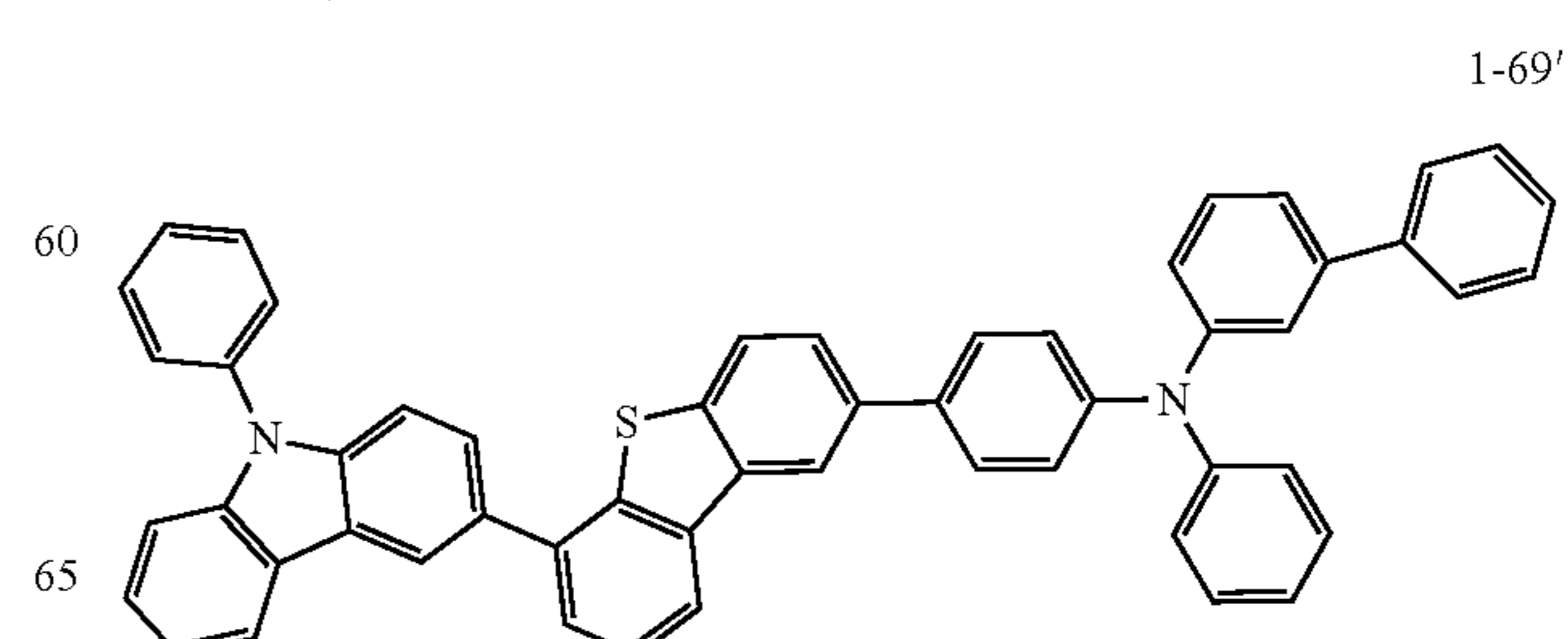
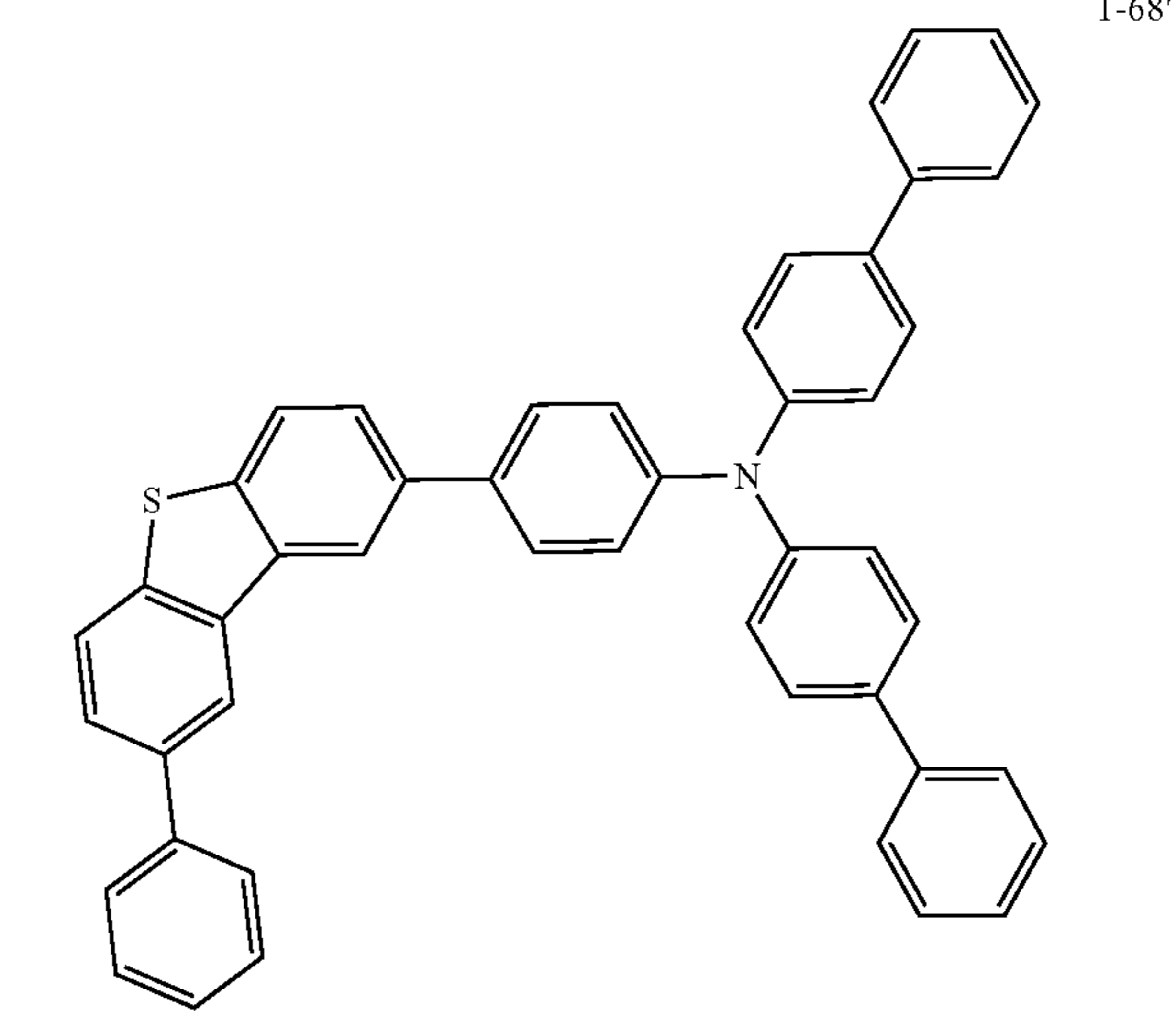
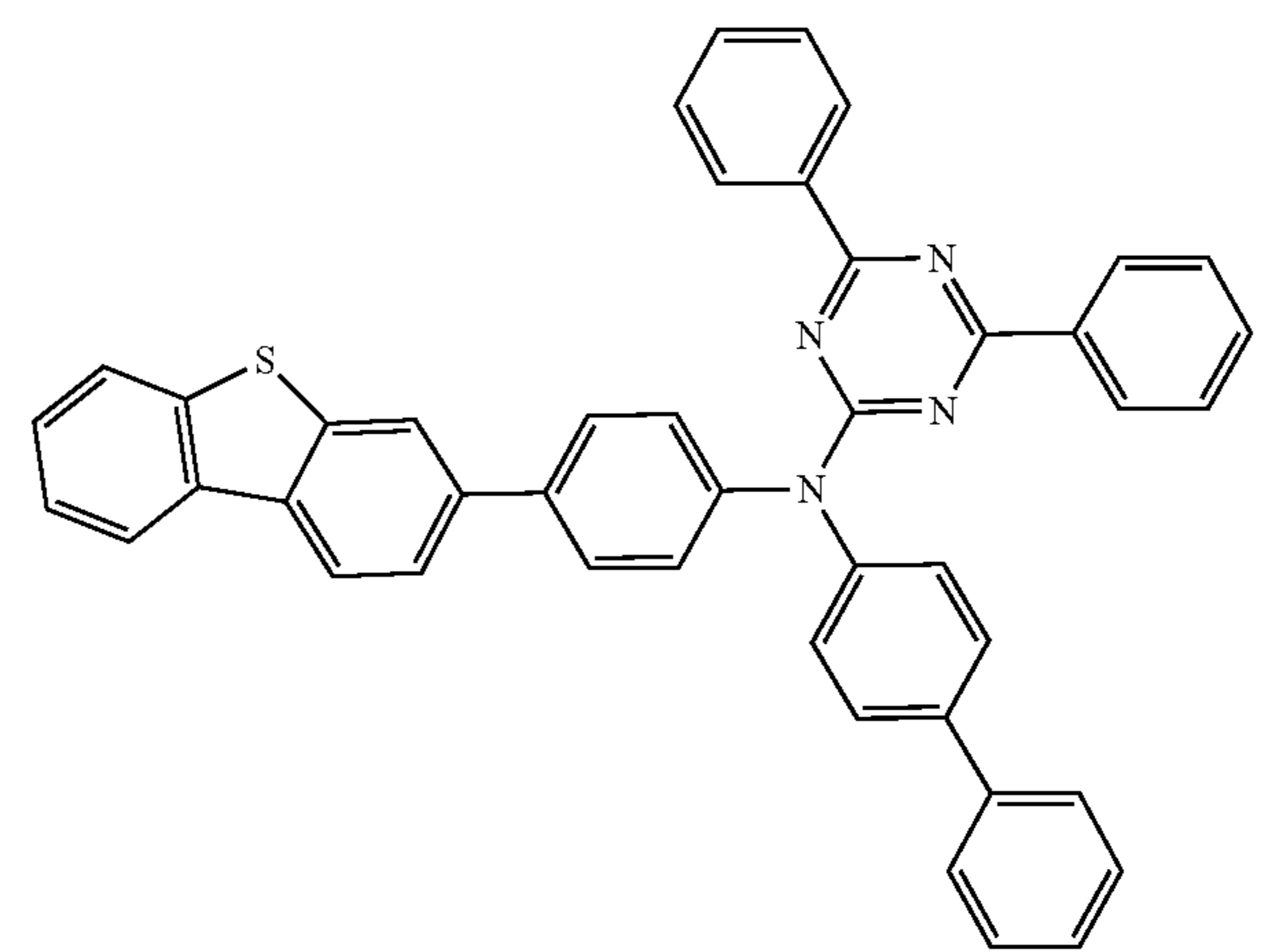
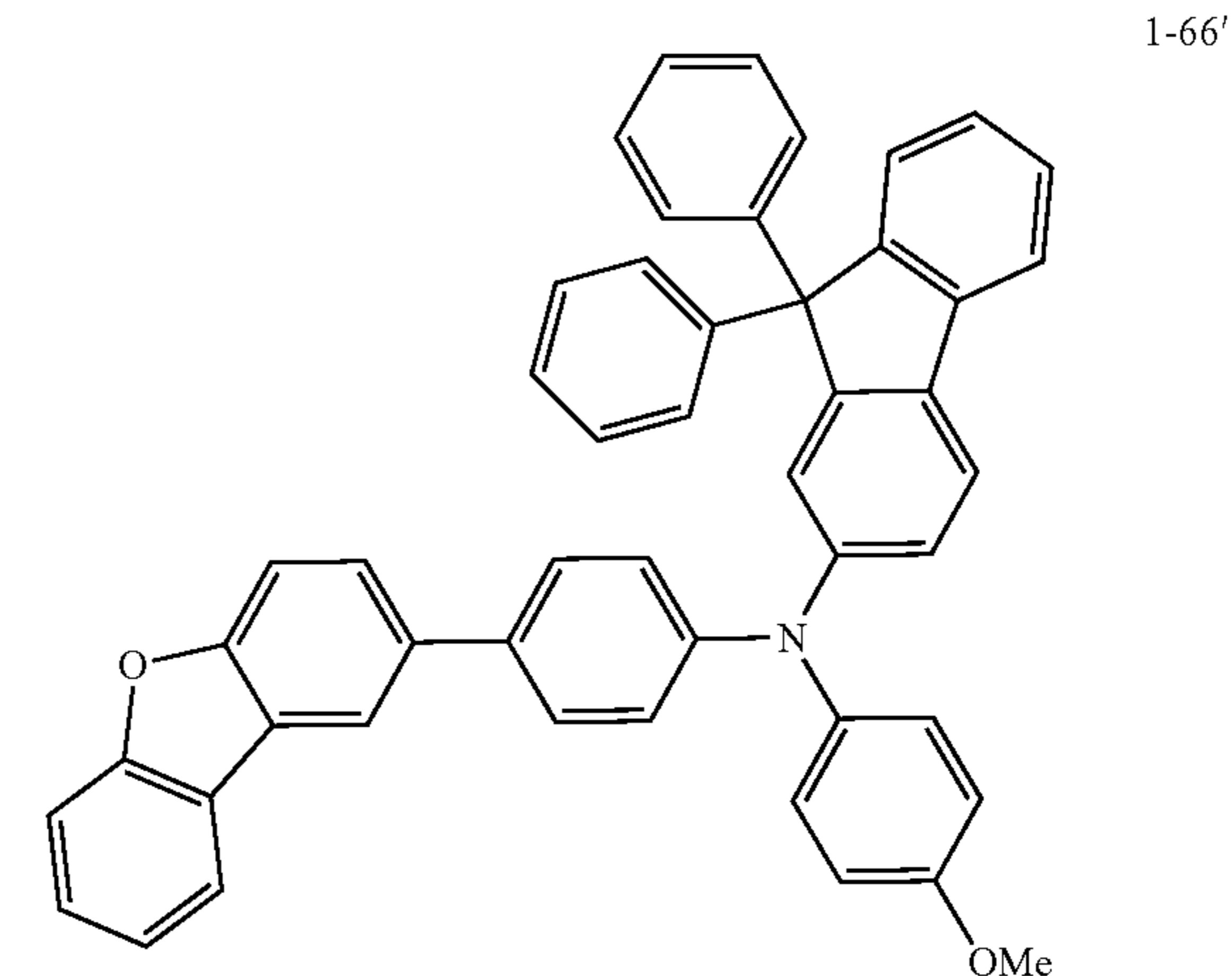
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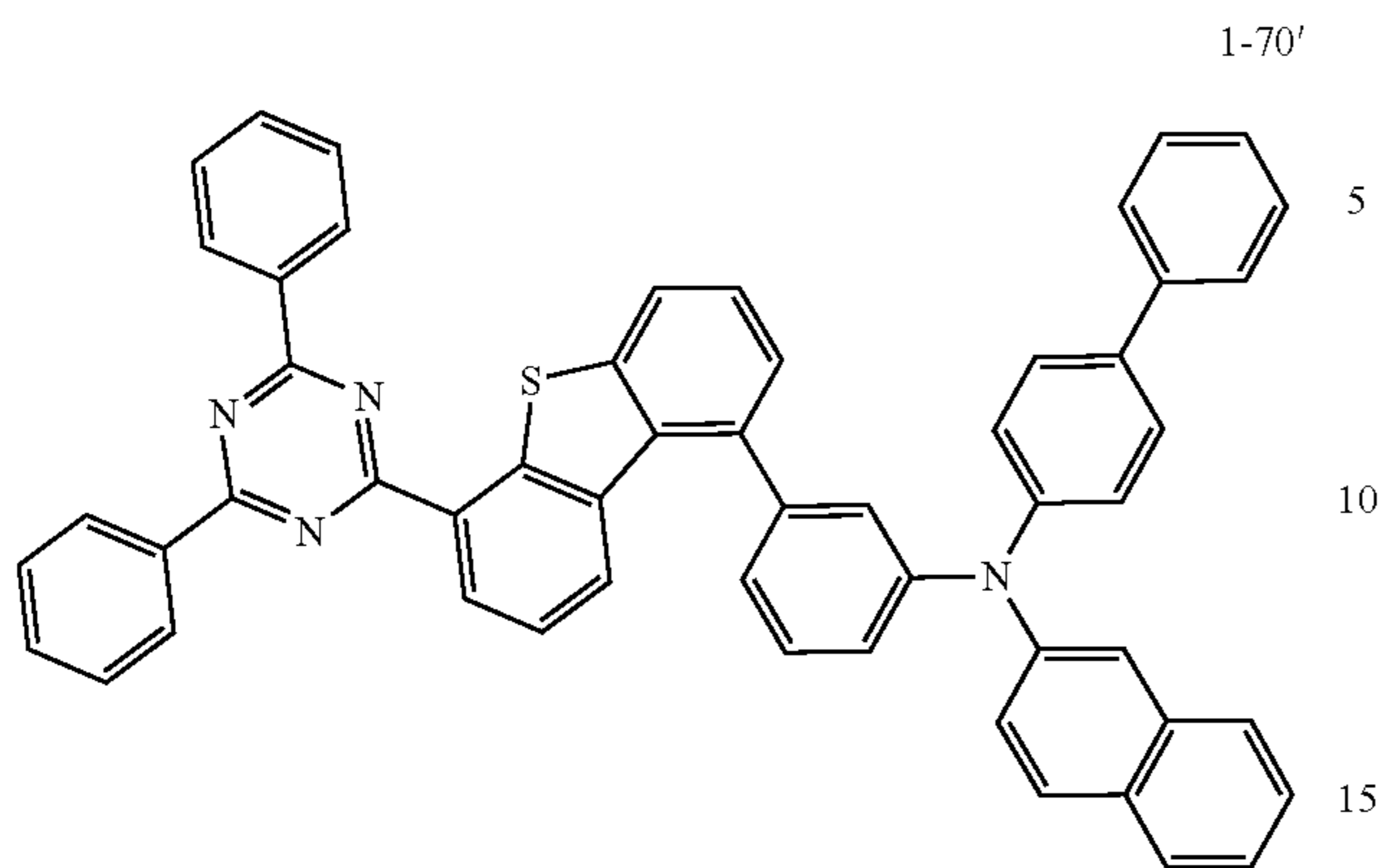
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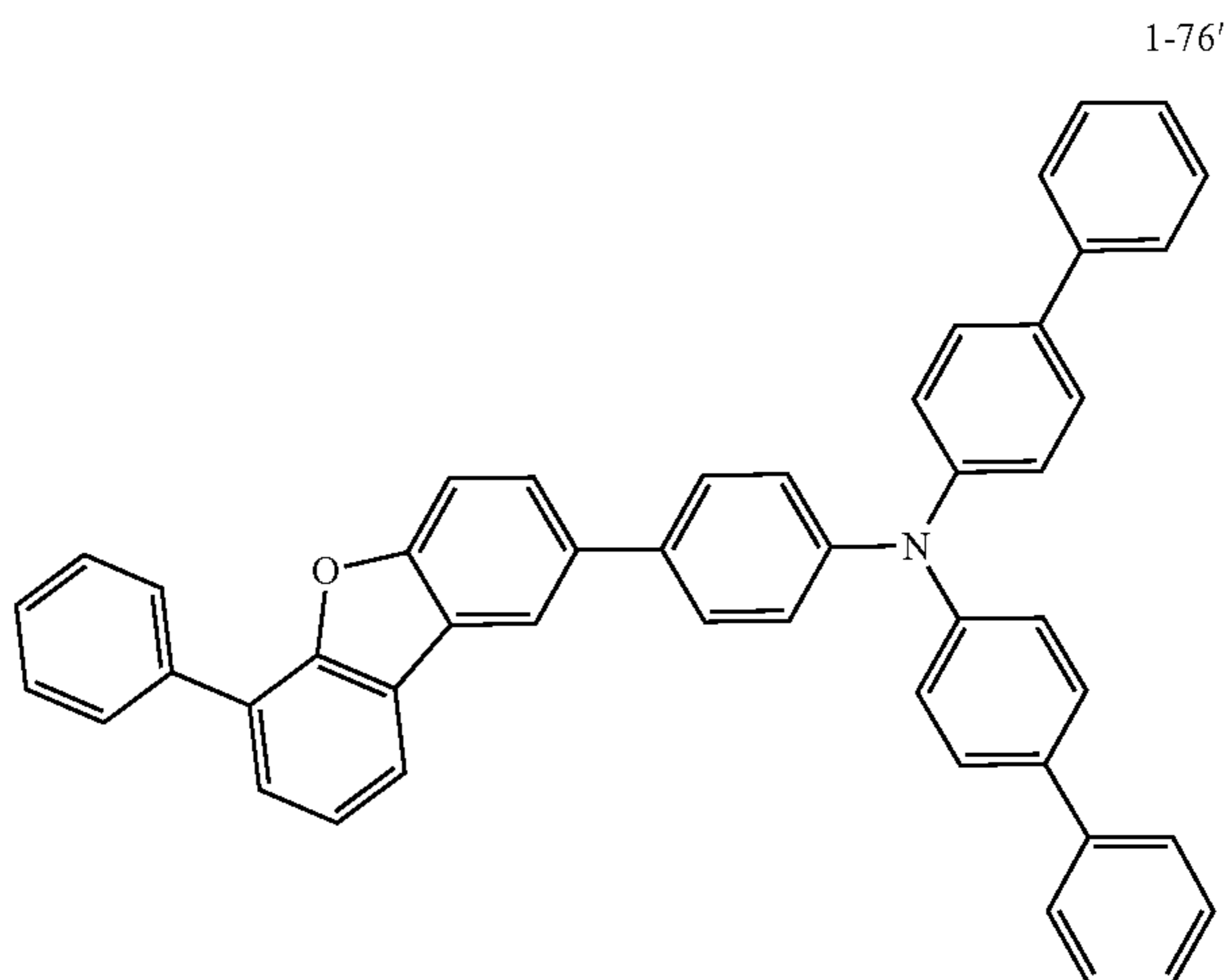
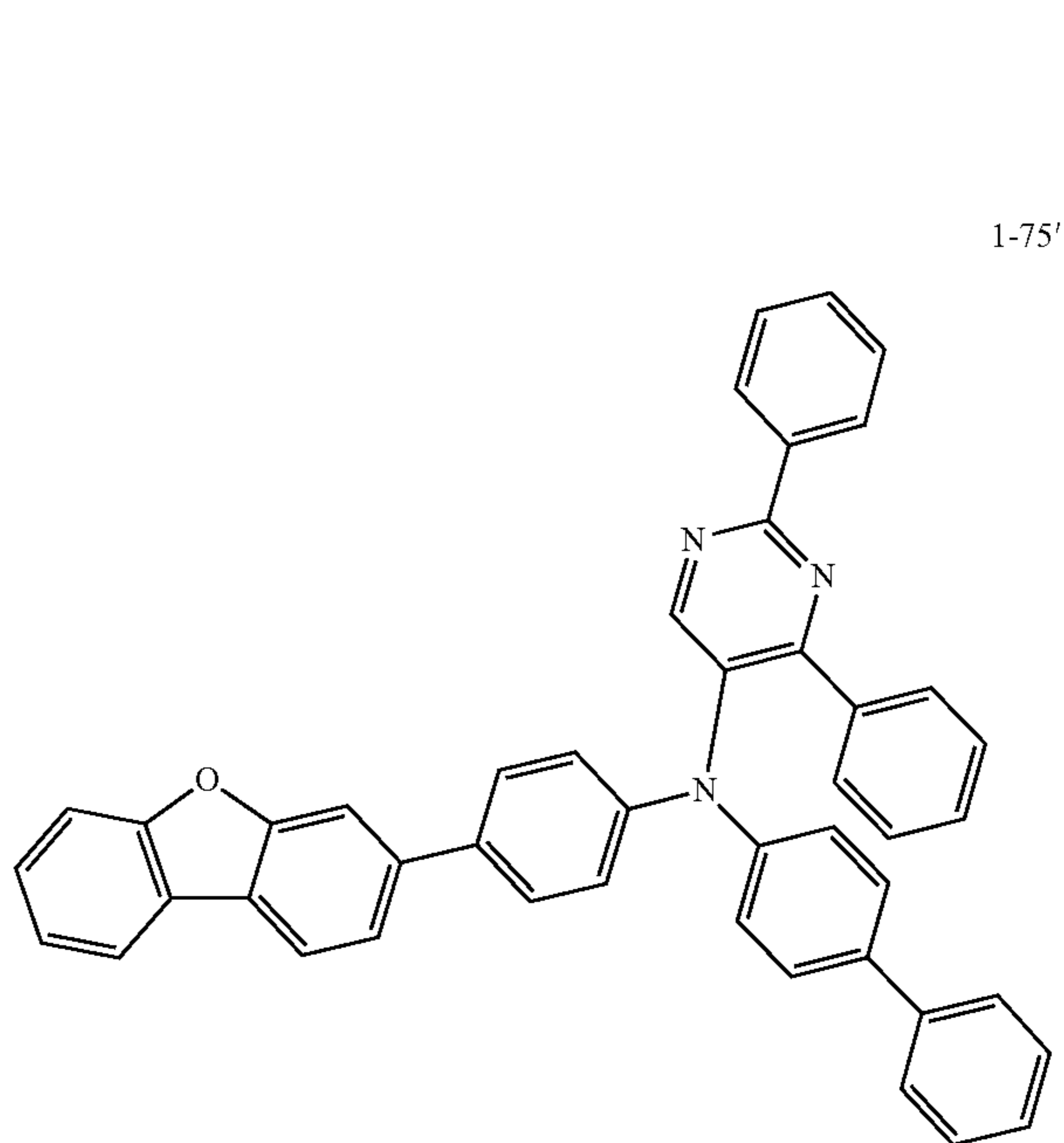
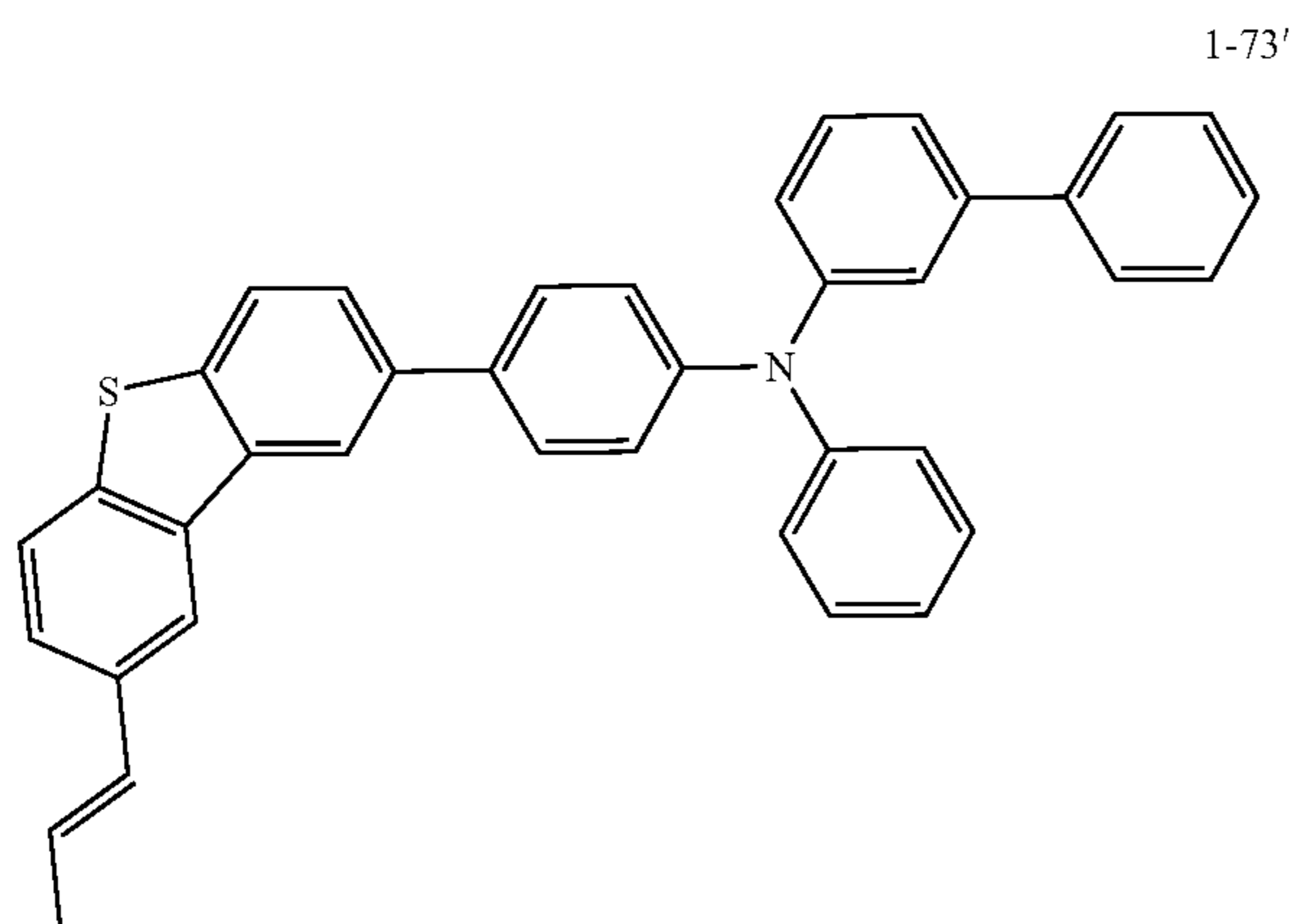
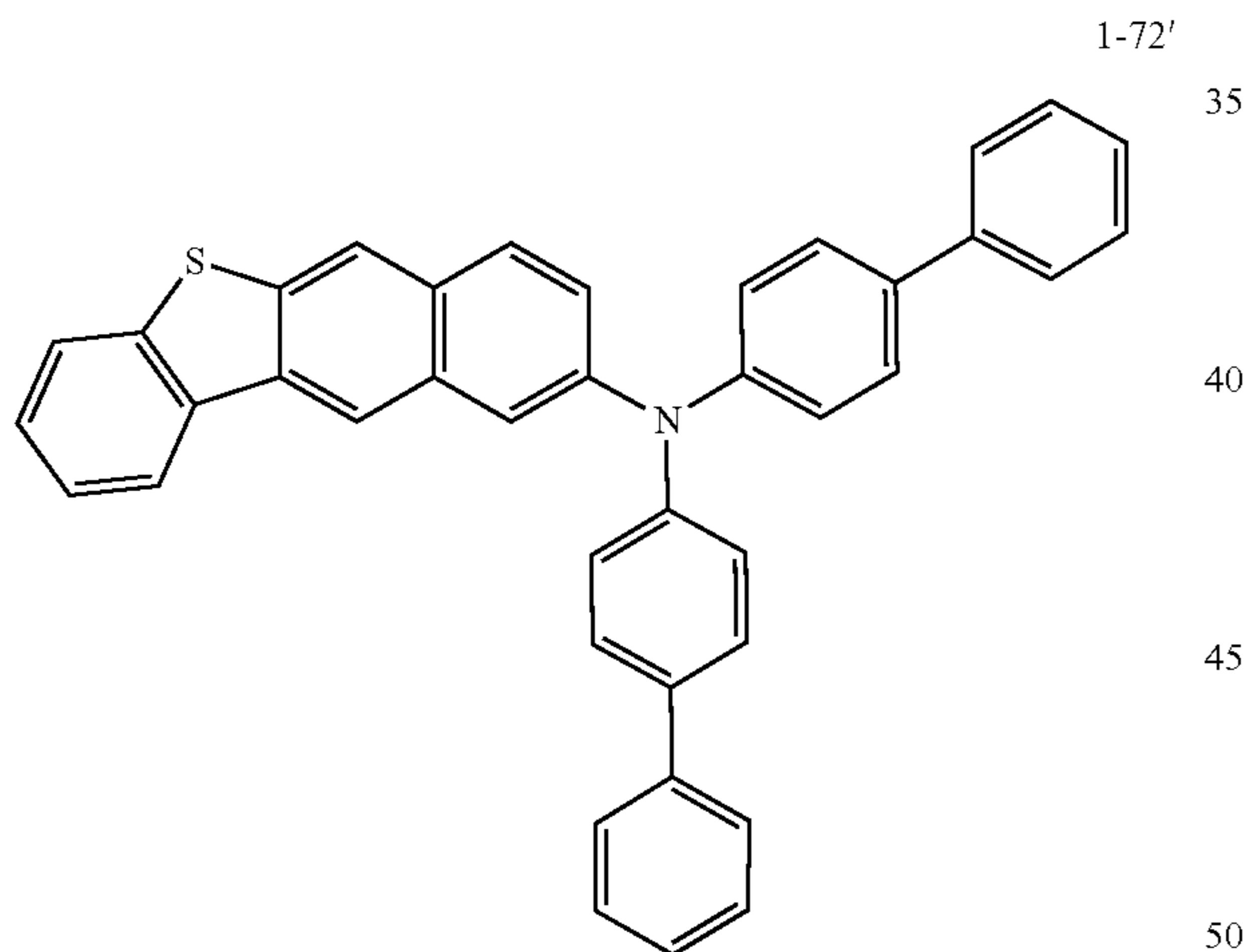
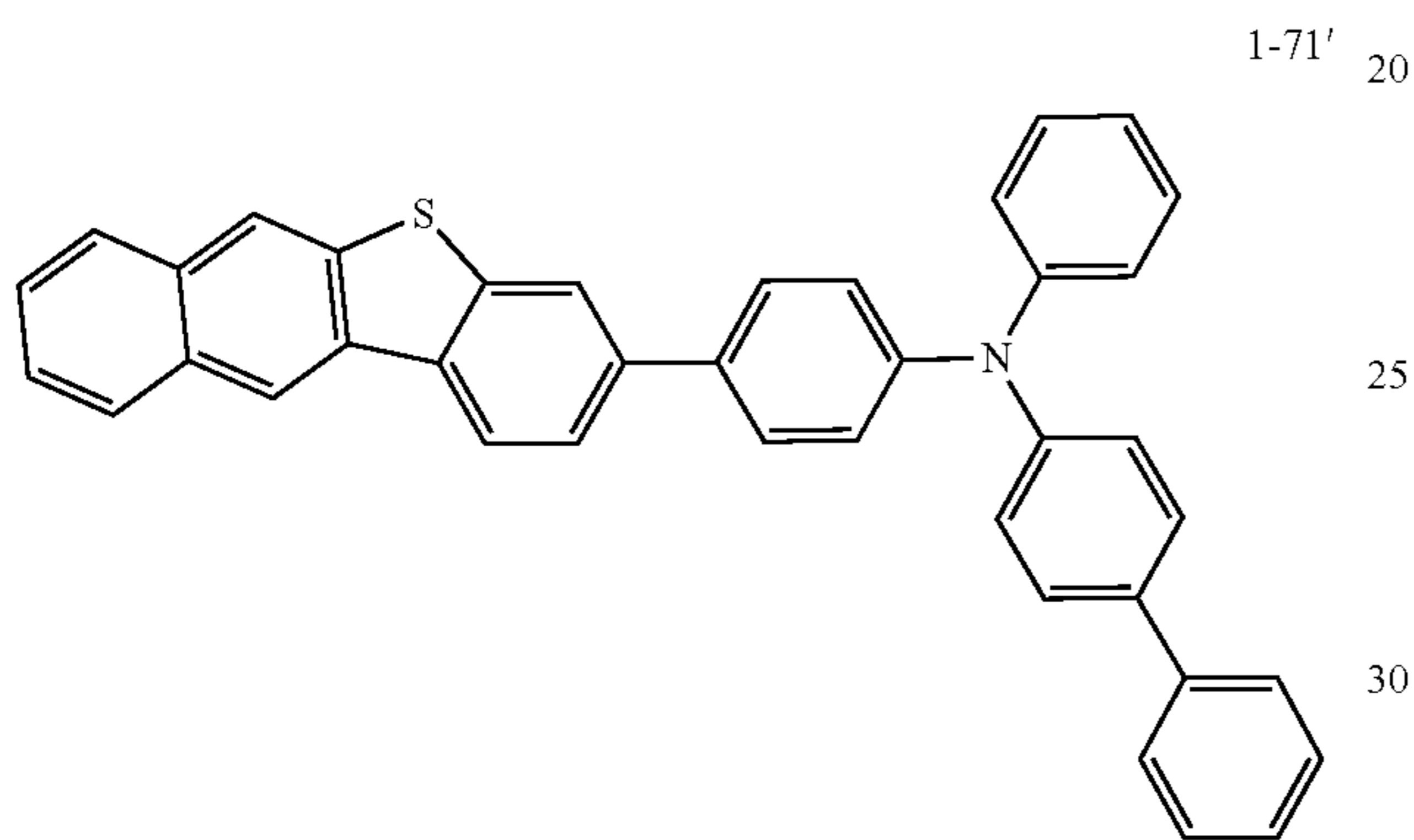
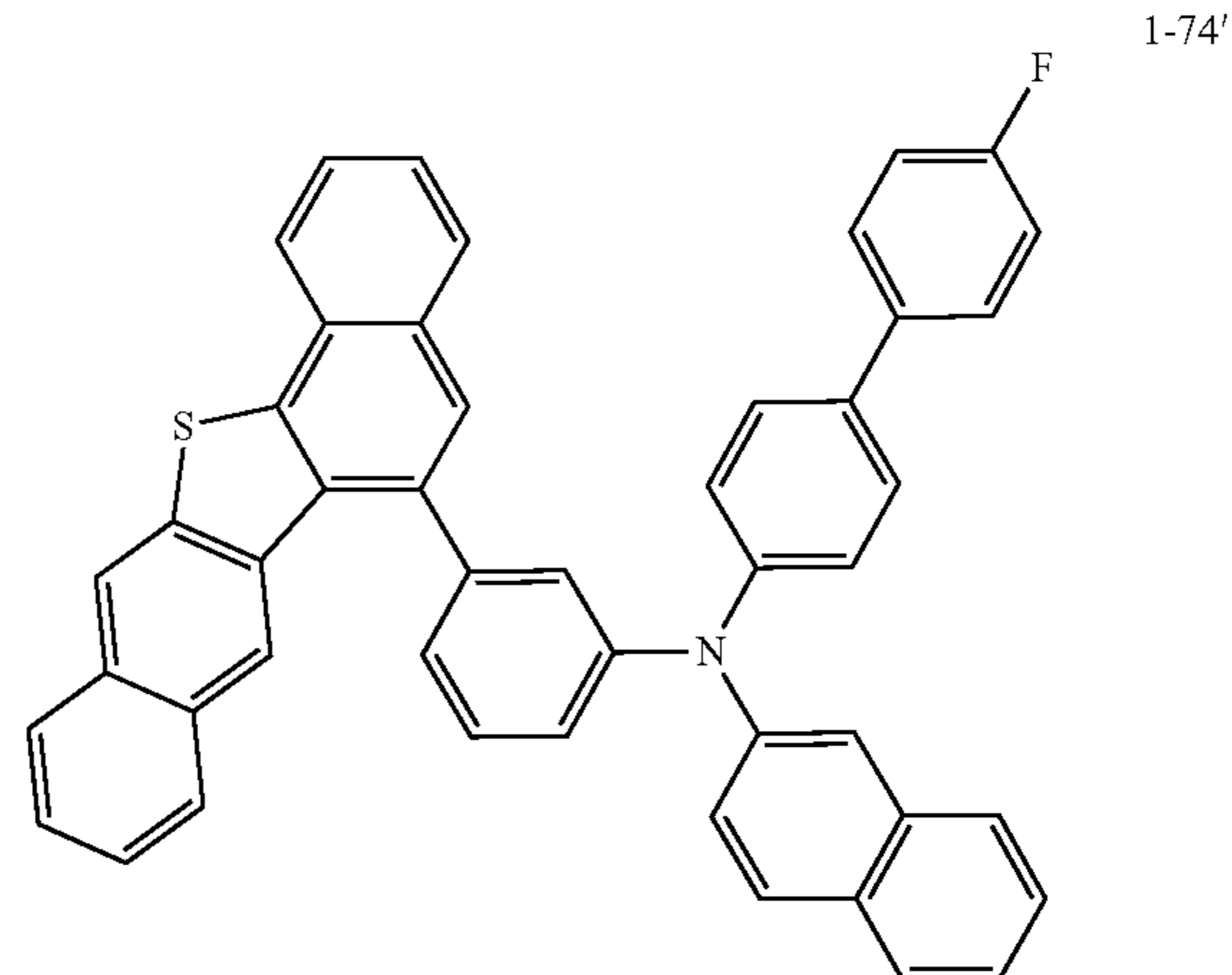
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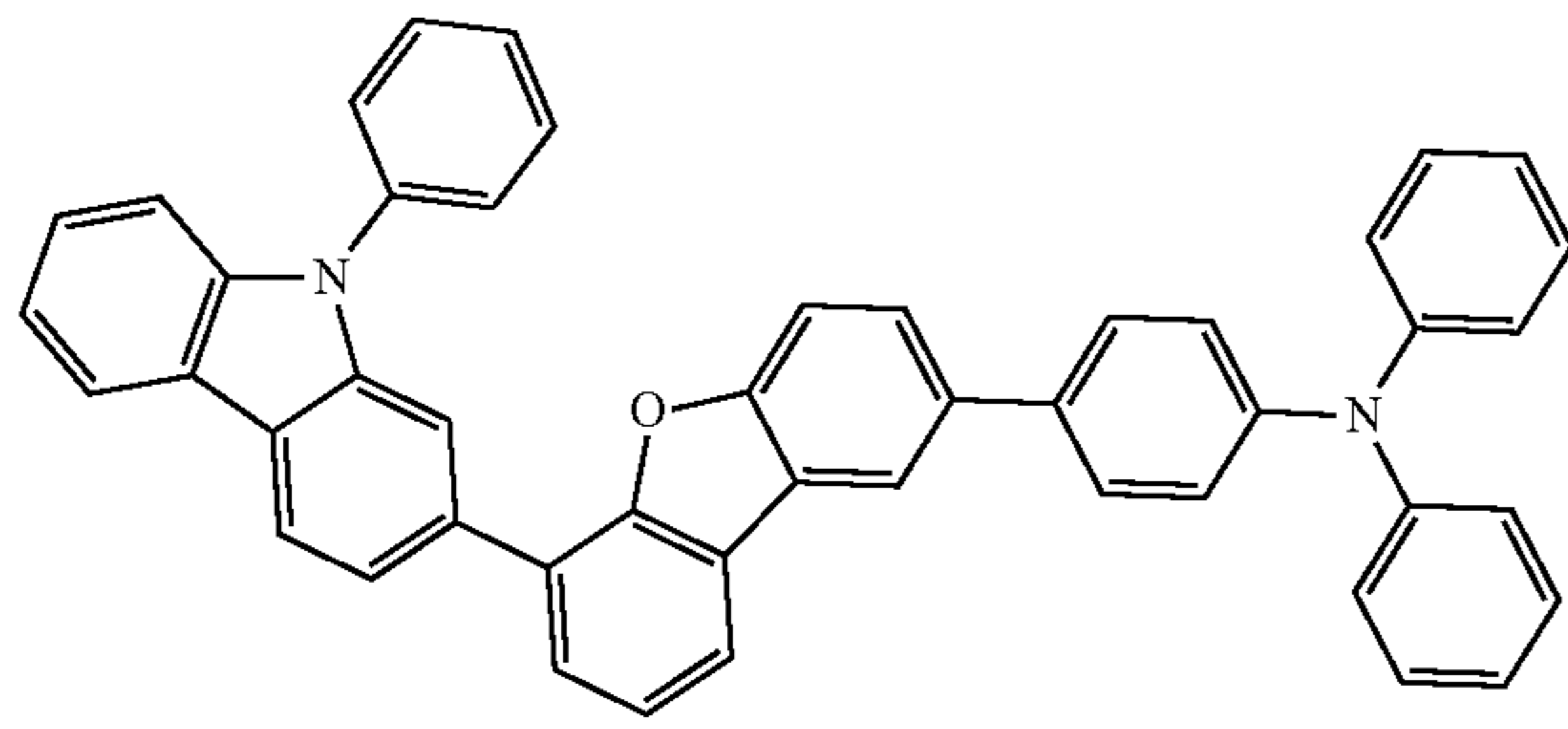
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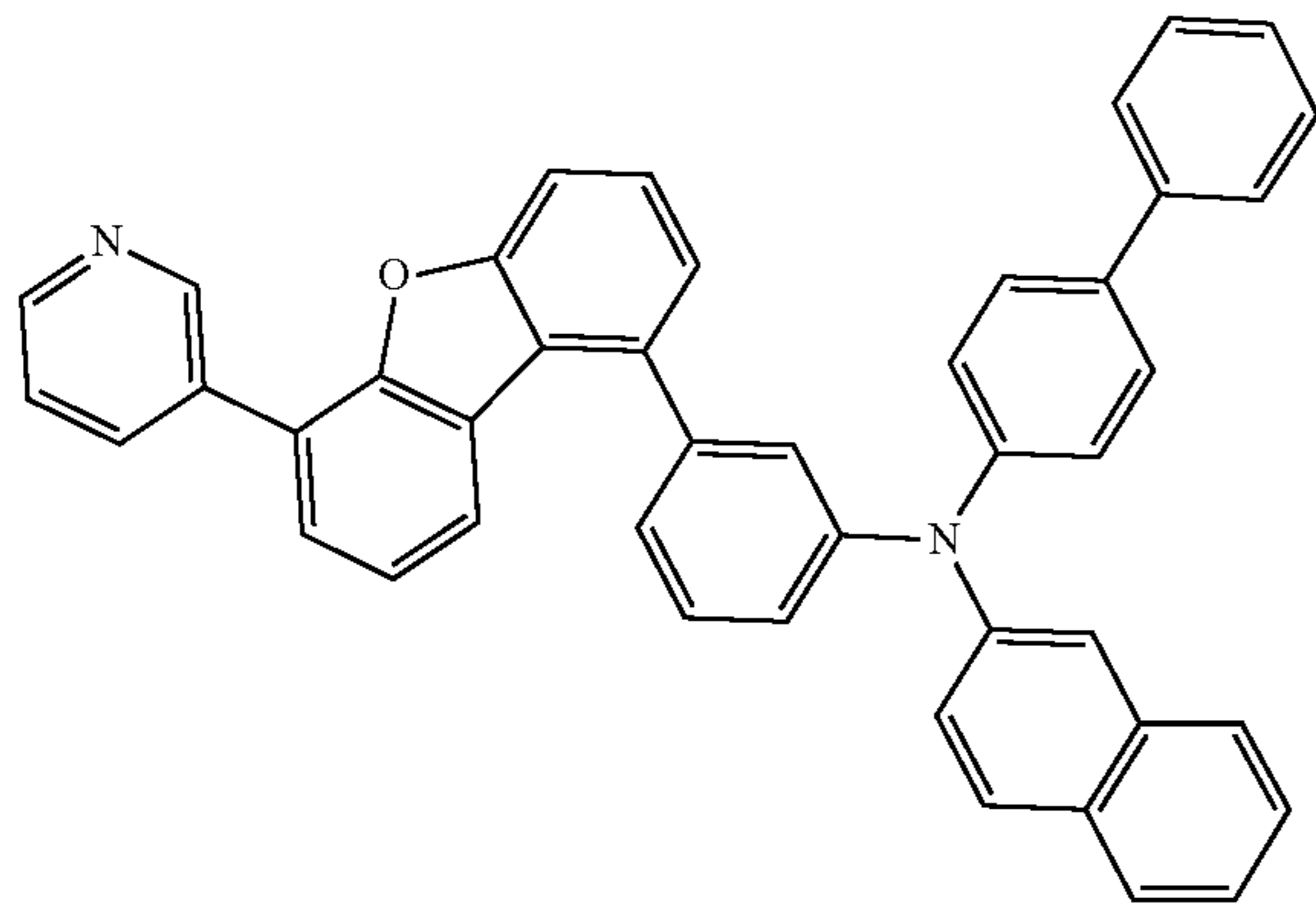


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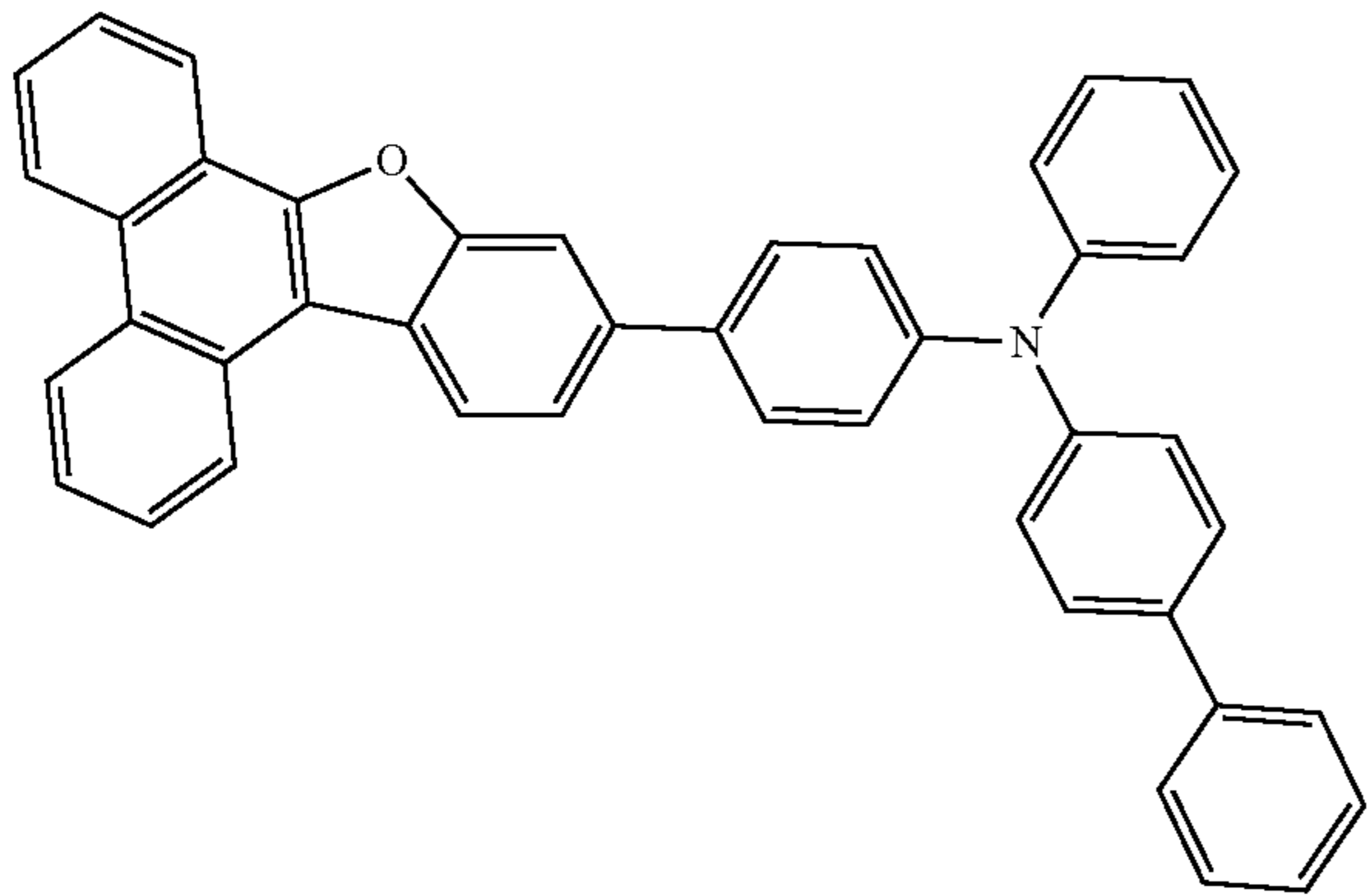
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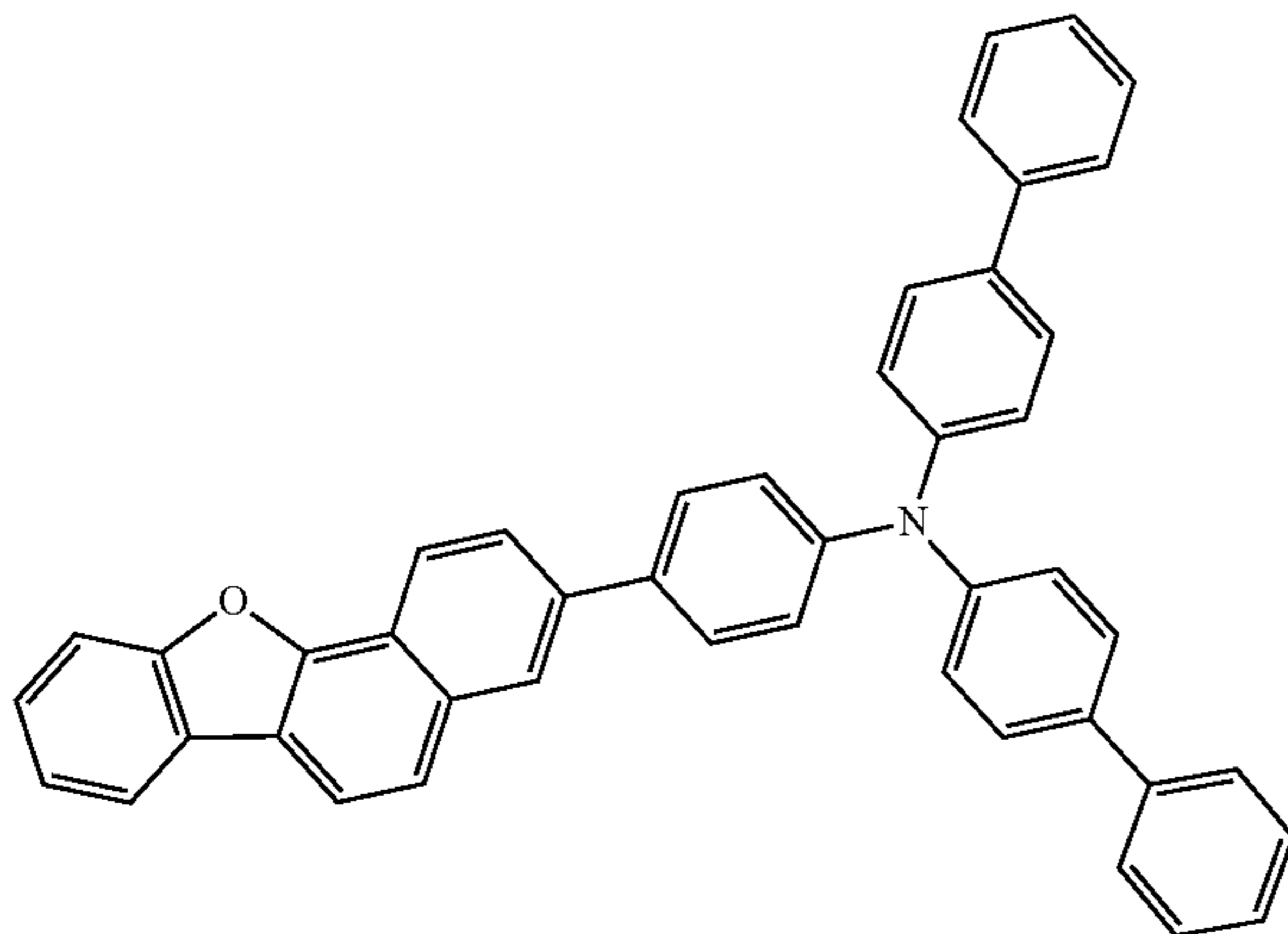


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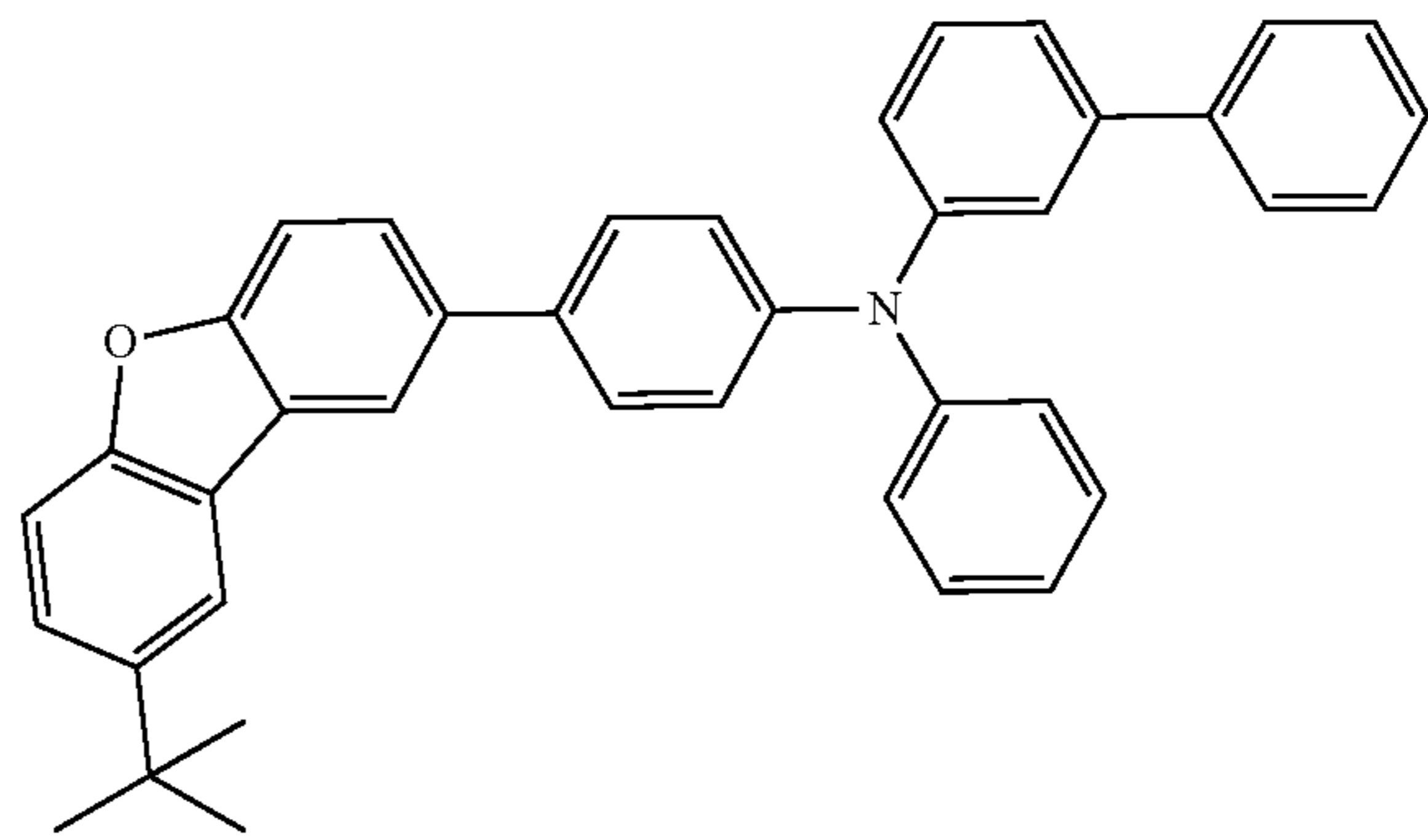
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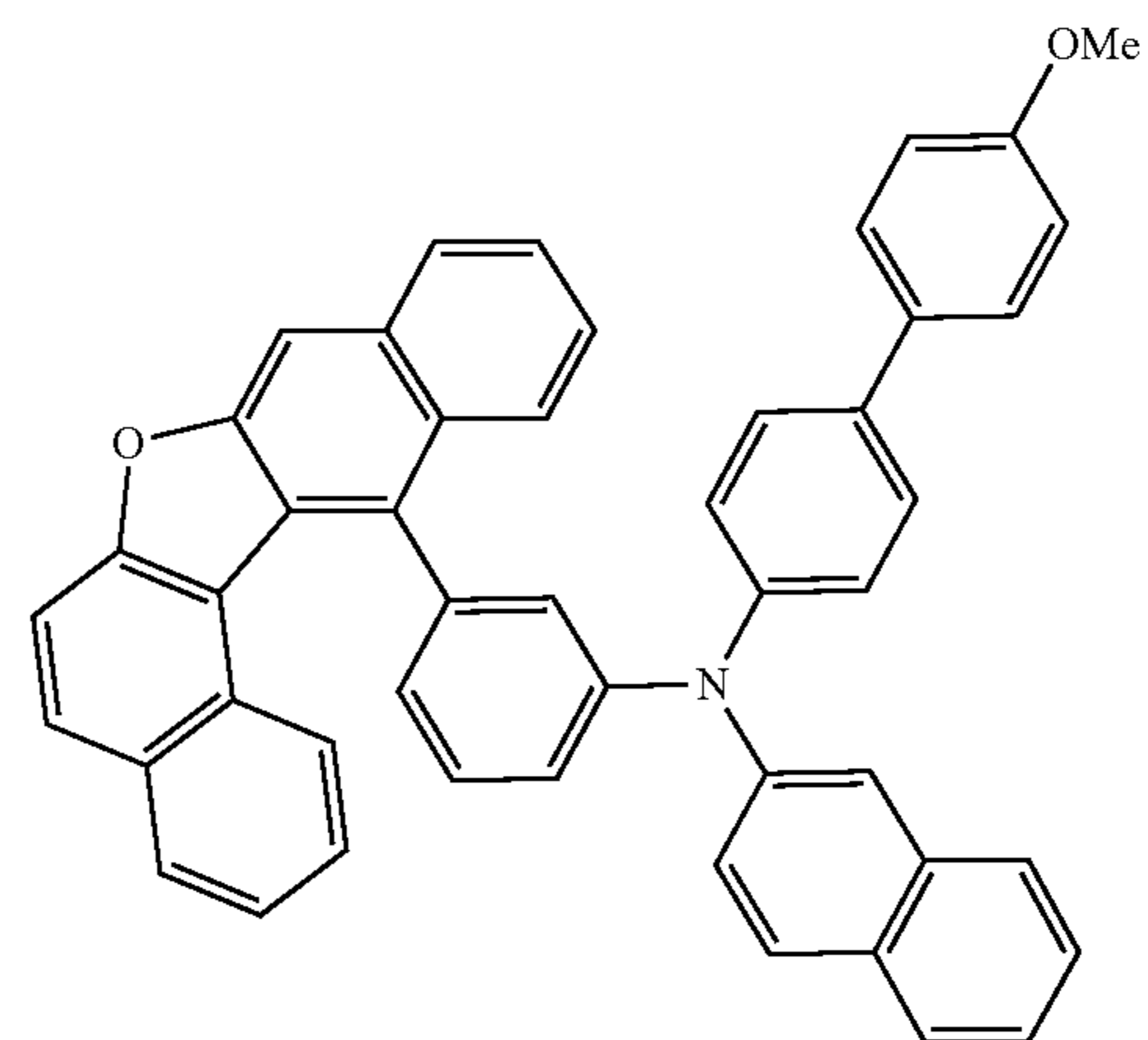
52

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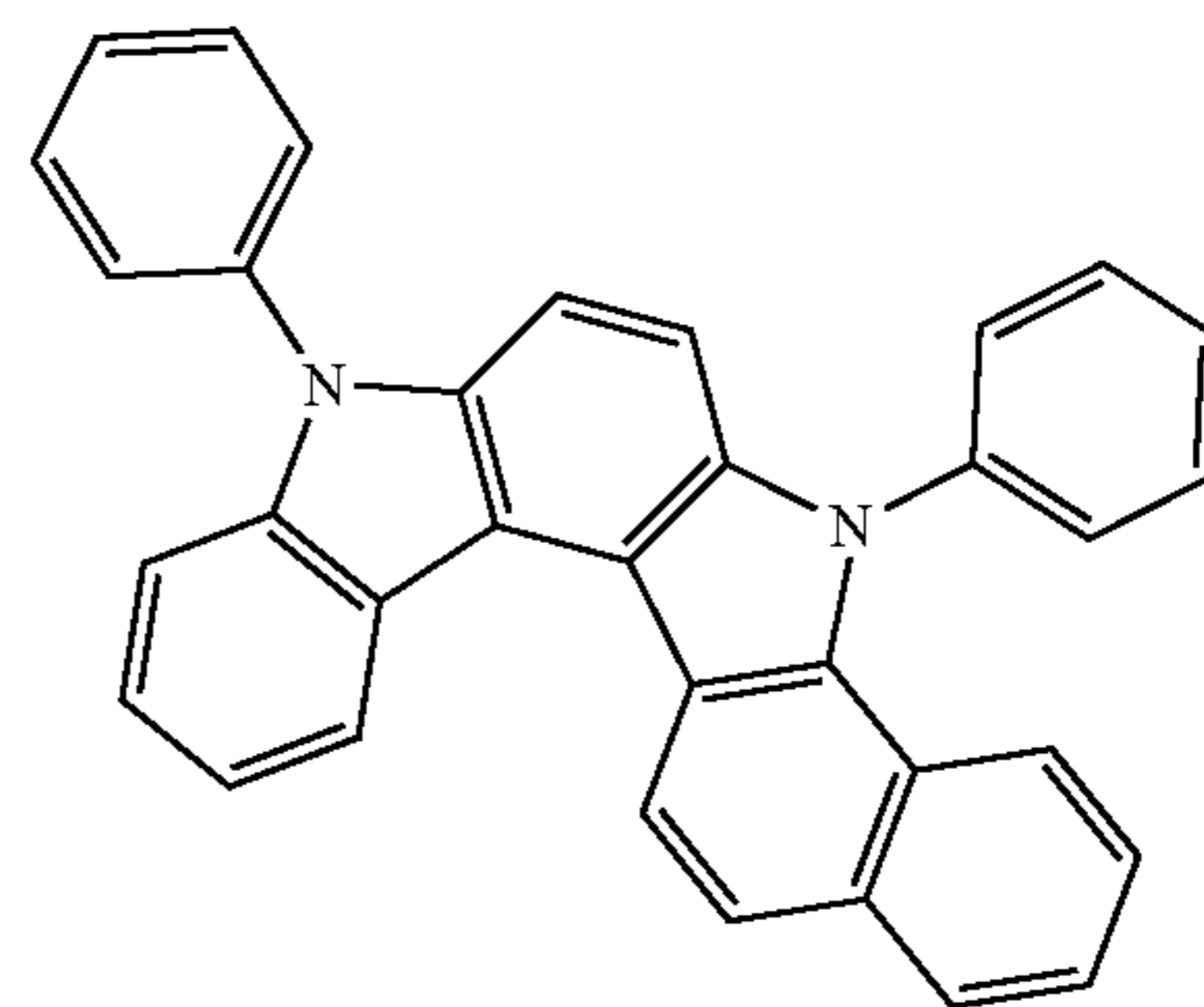


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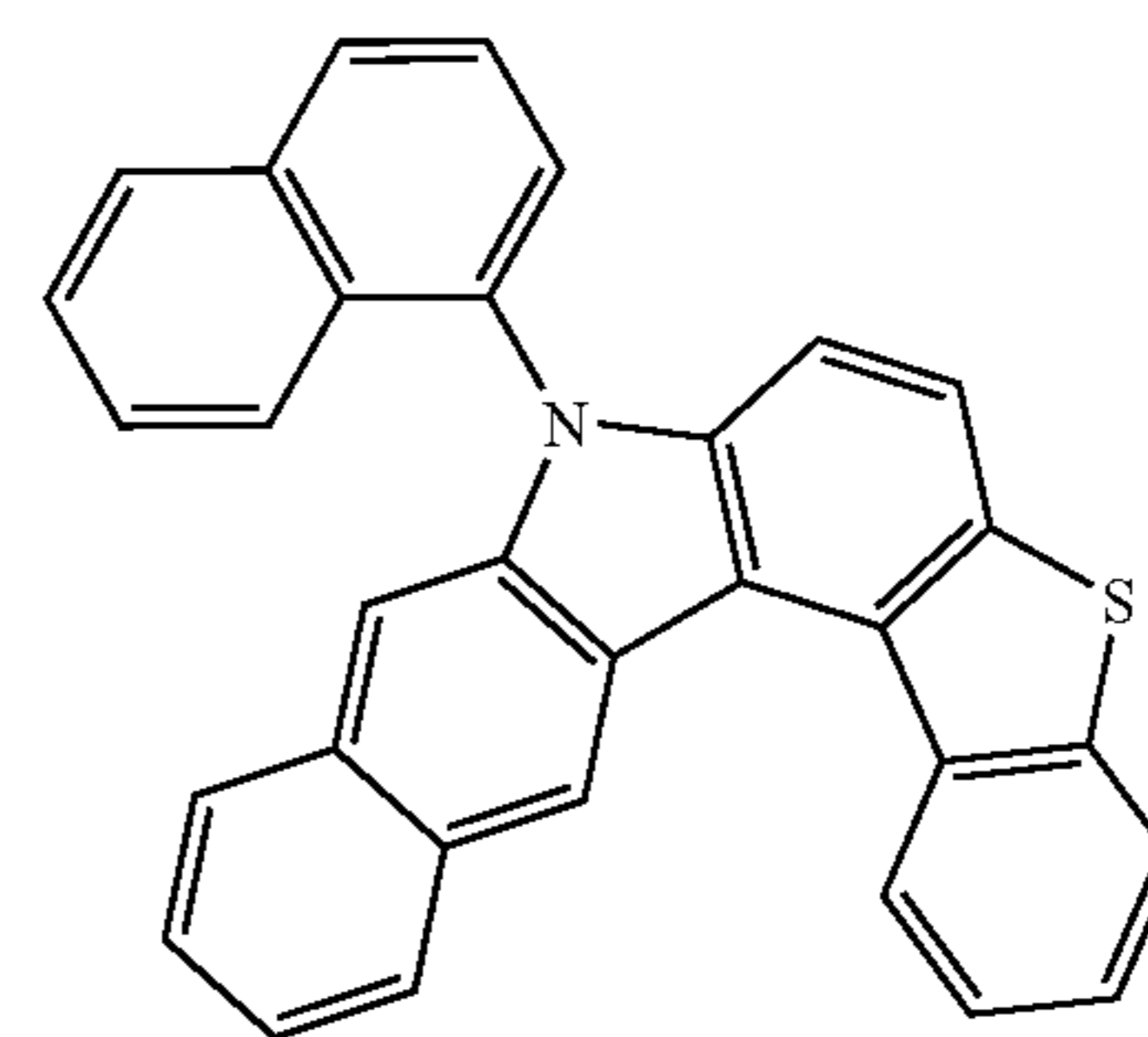


In the present invention, the second host compound represented by Formula (2) includes the following compounds 3-1 to 3-100.

3-1

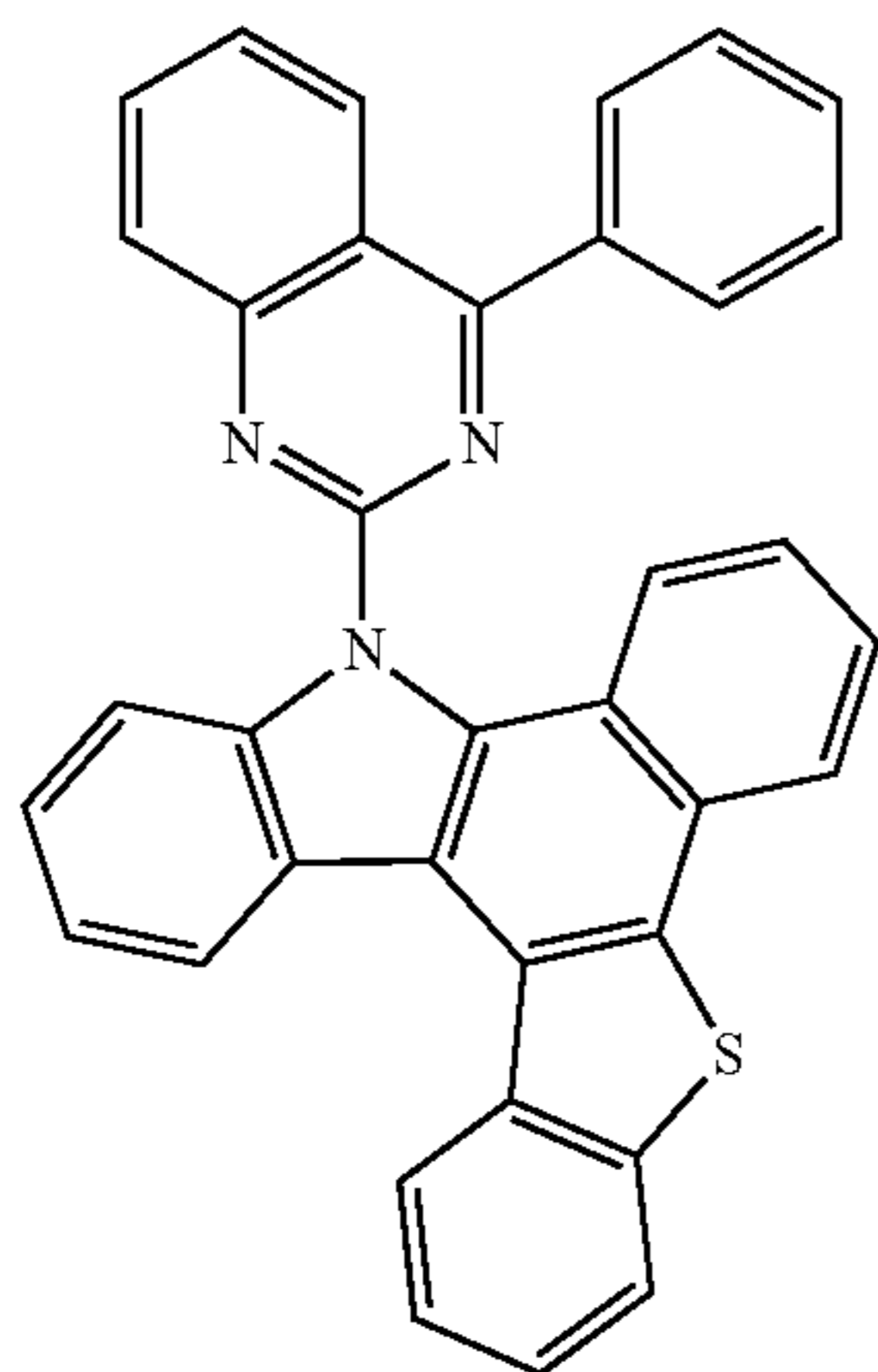
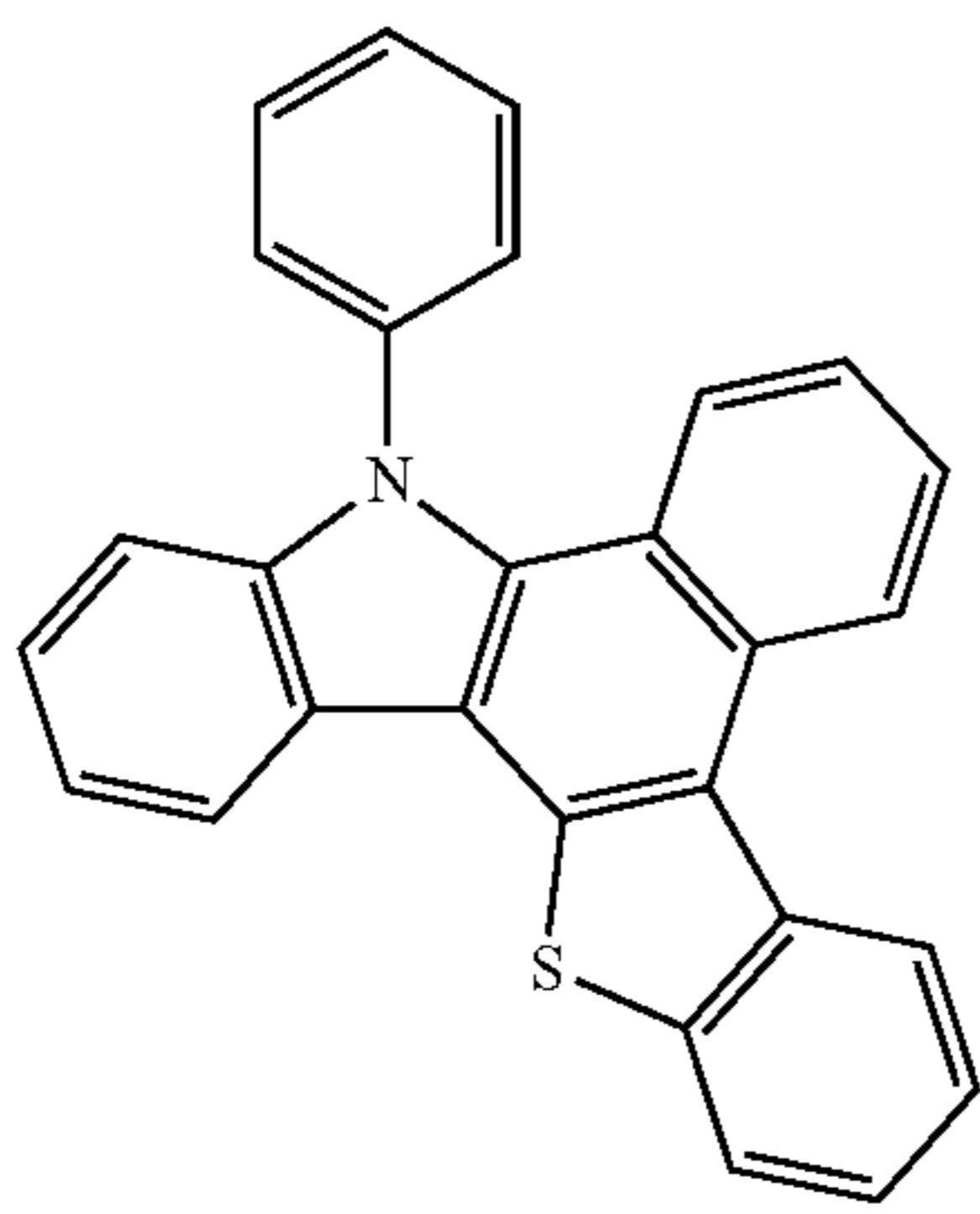
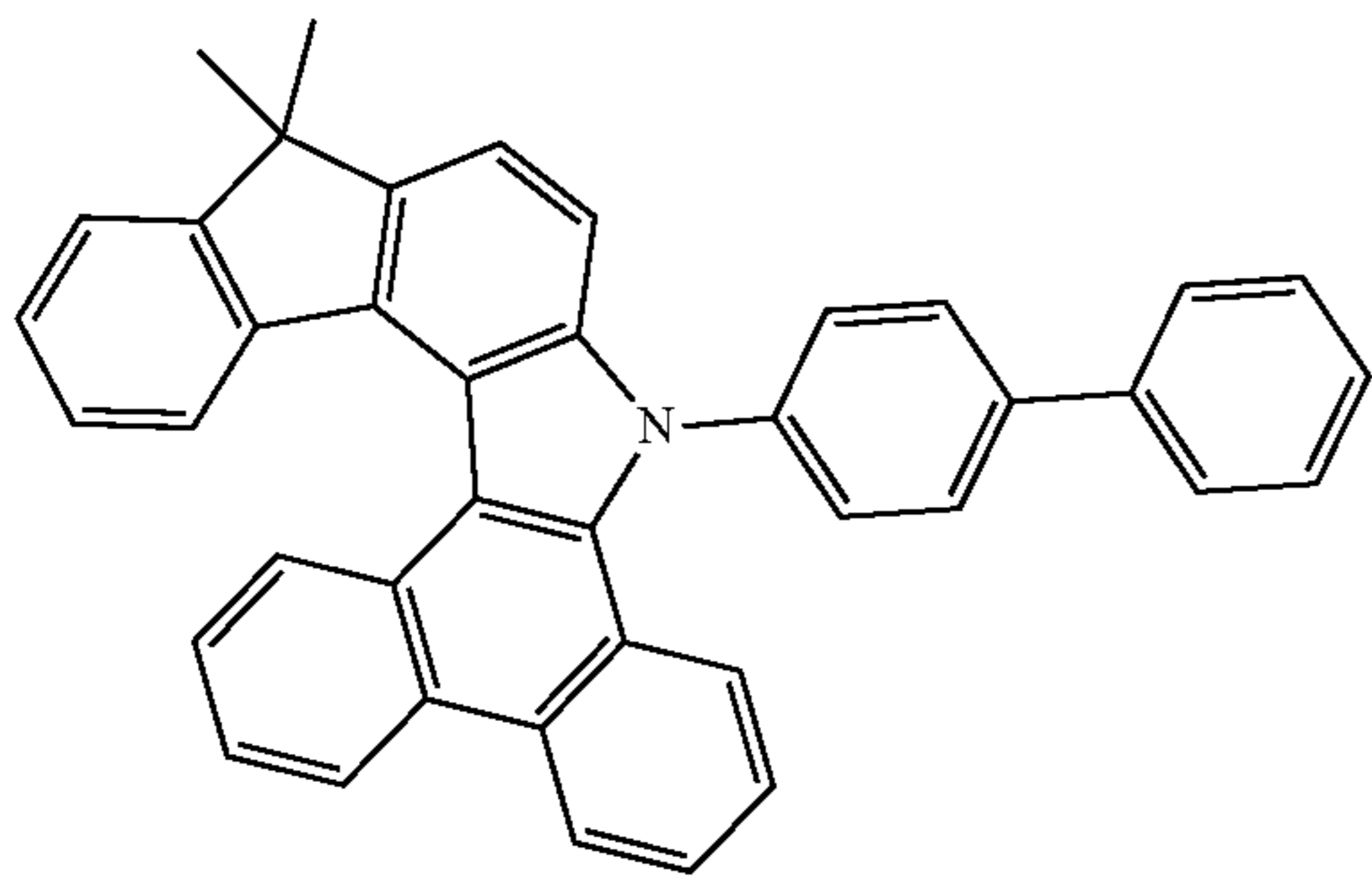
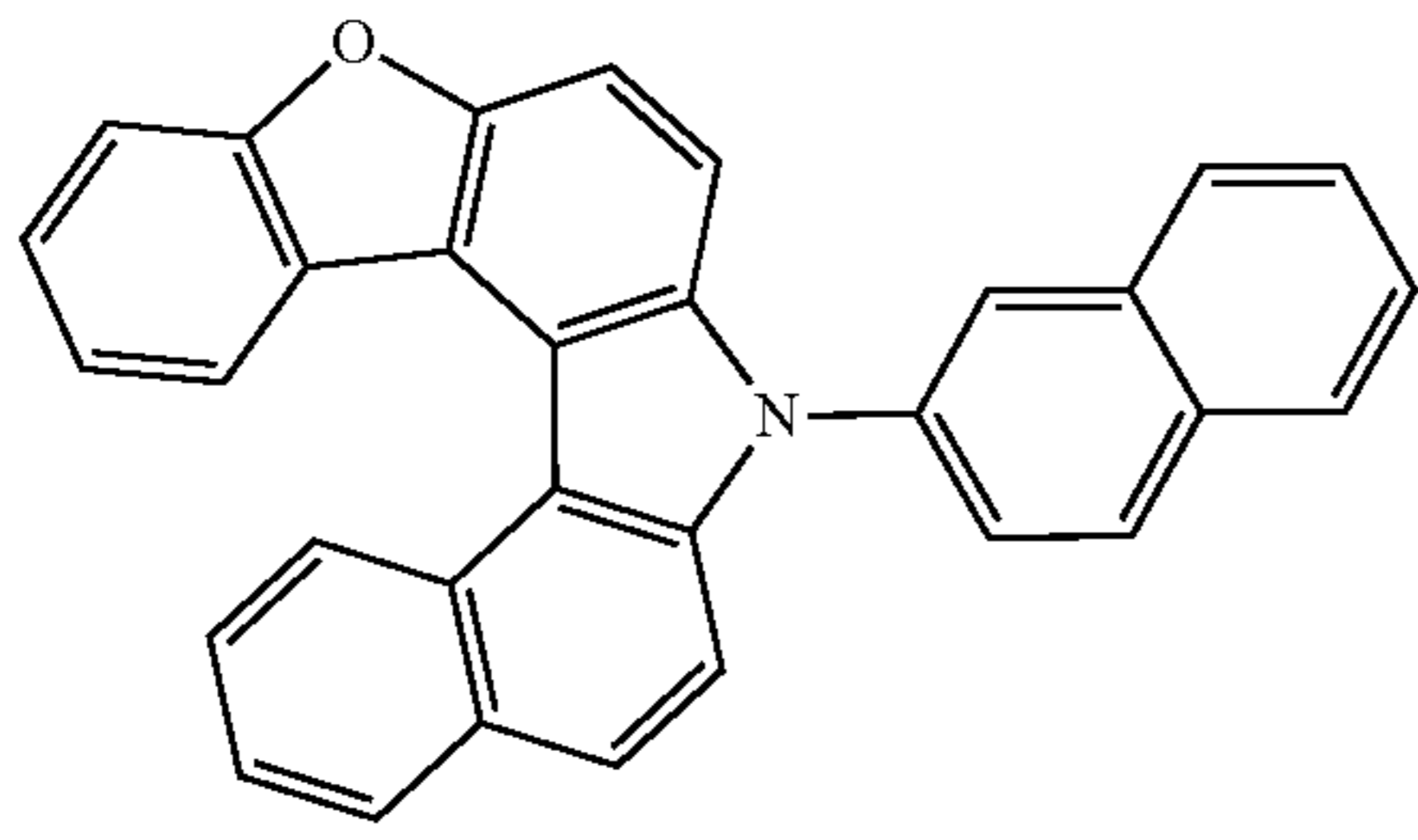


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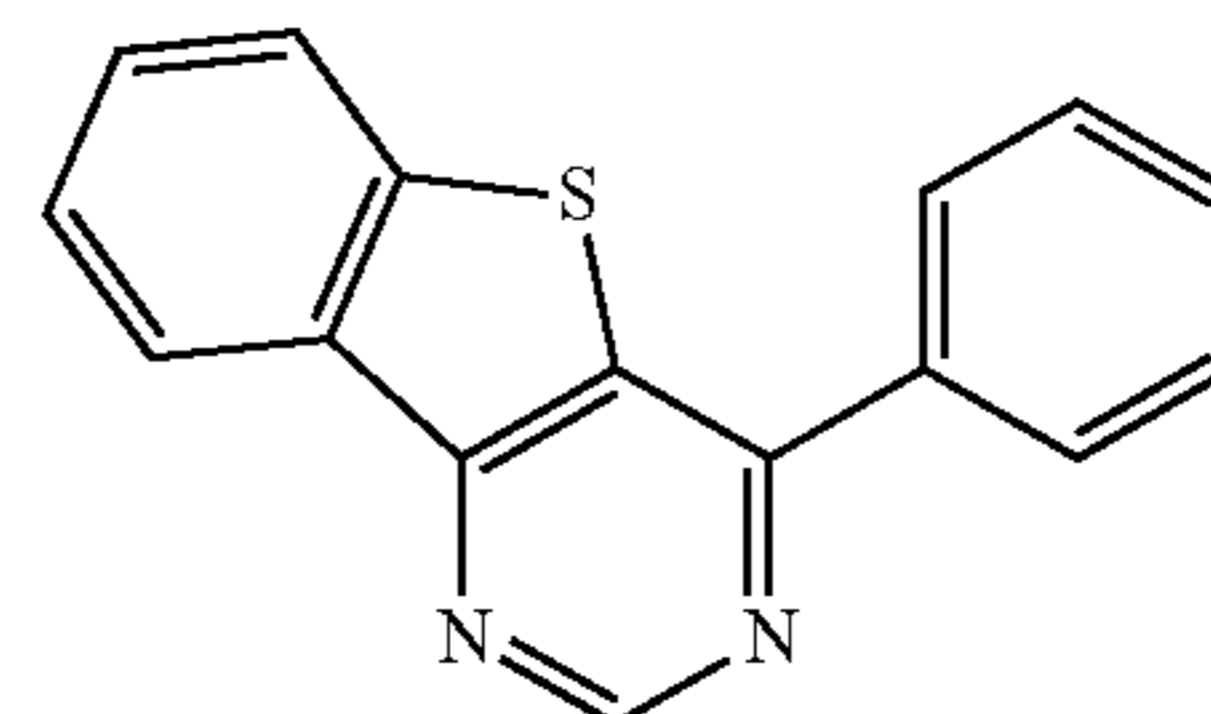
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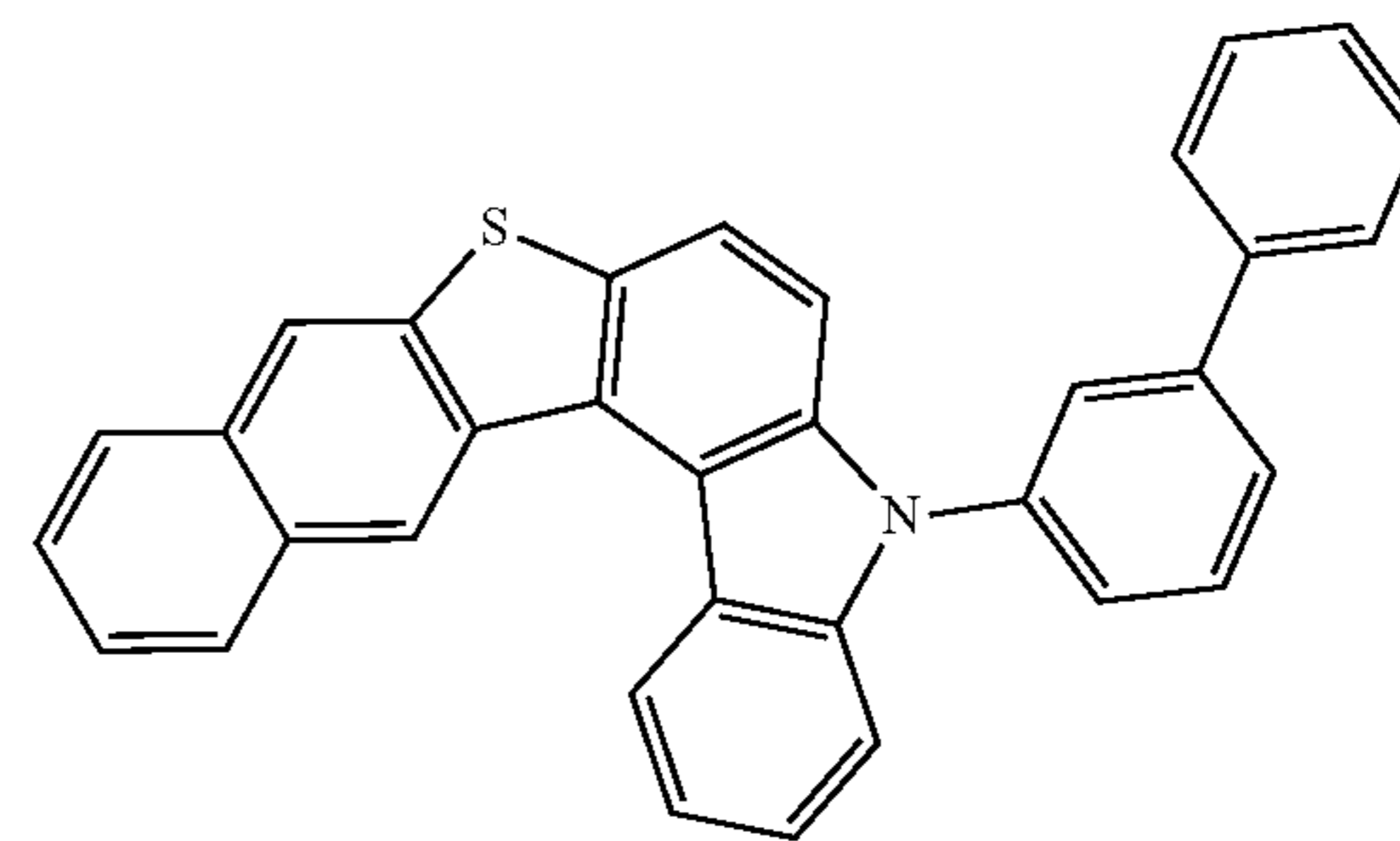
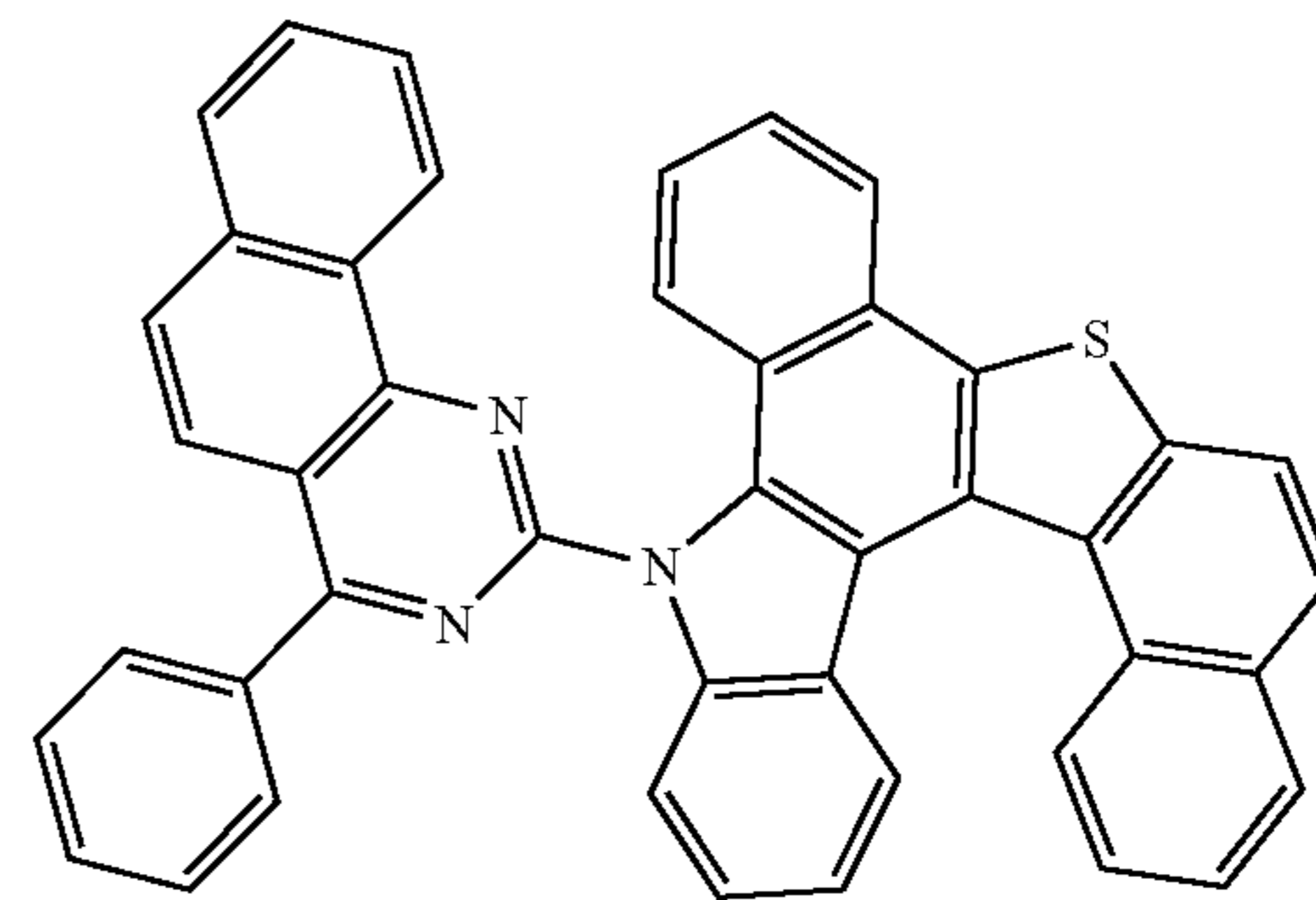
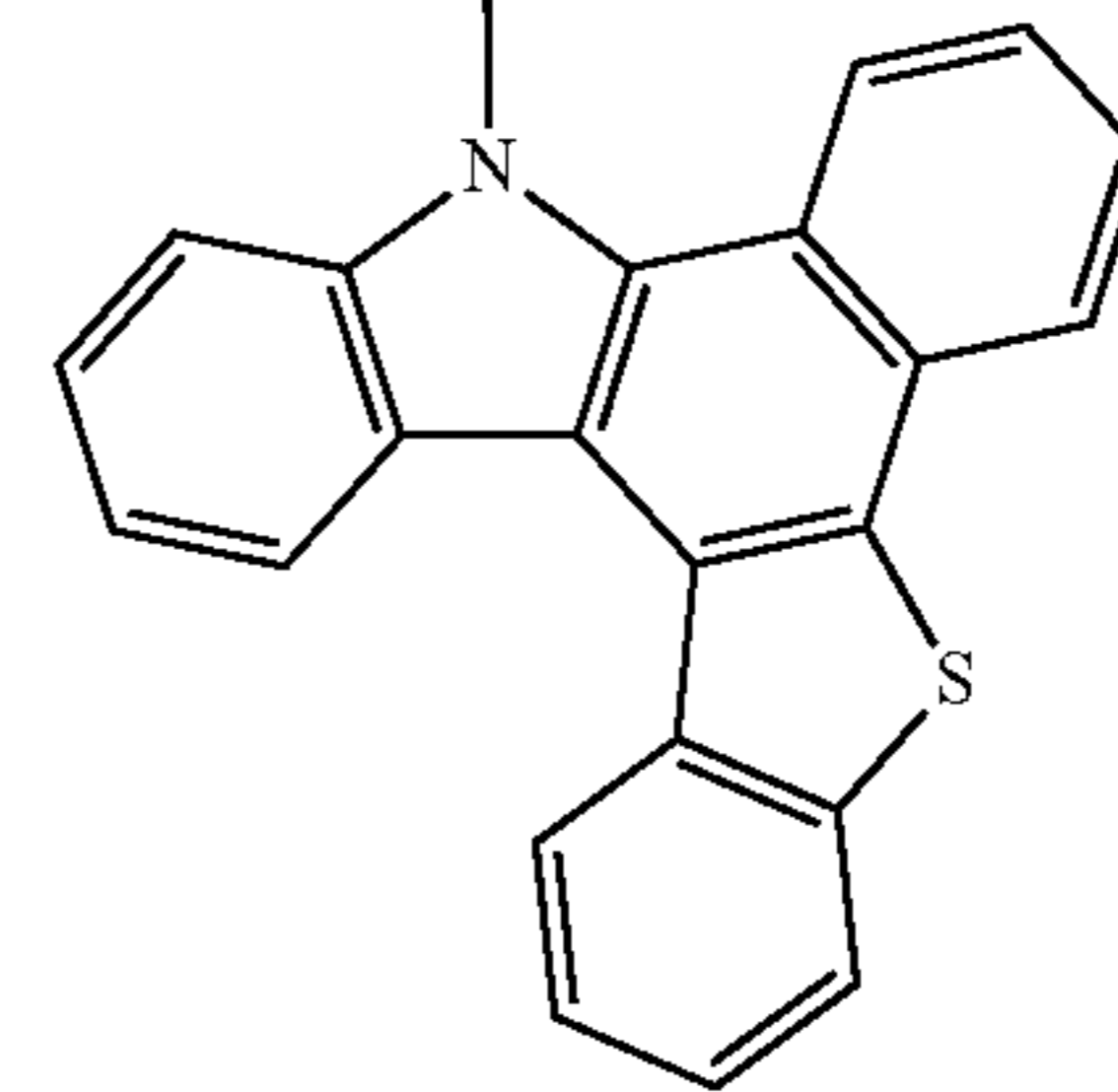
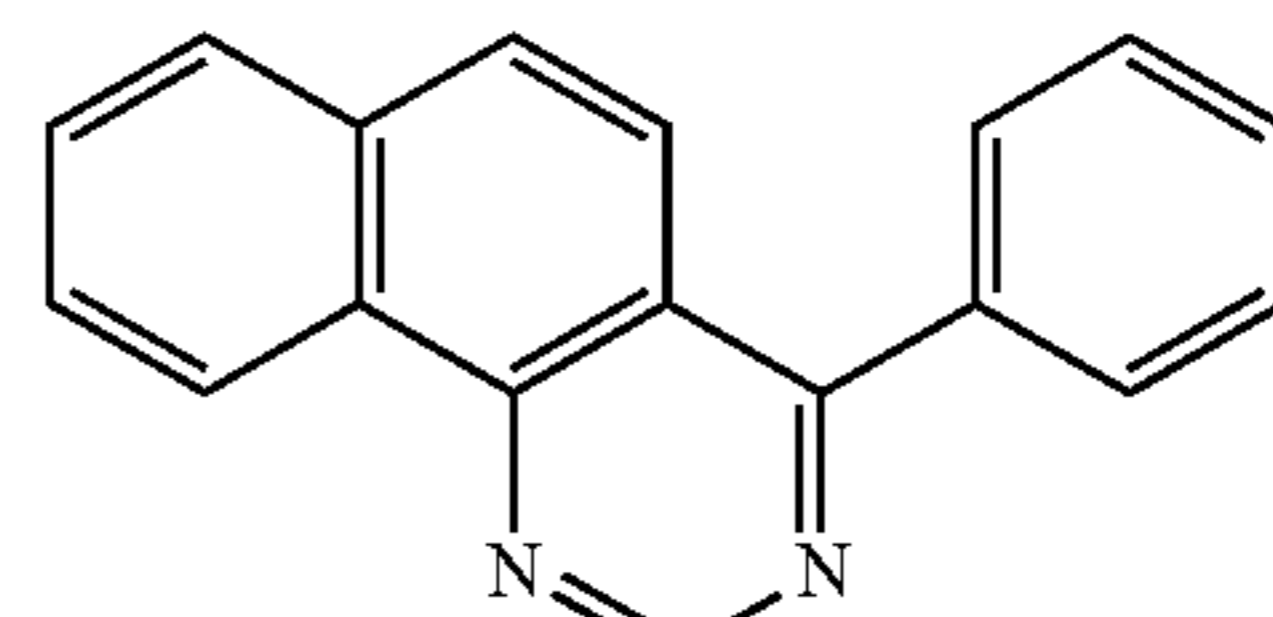
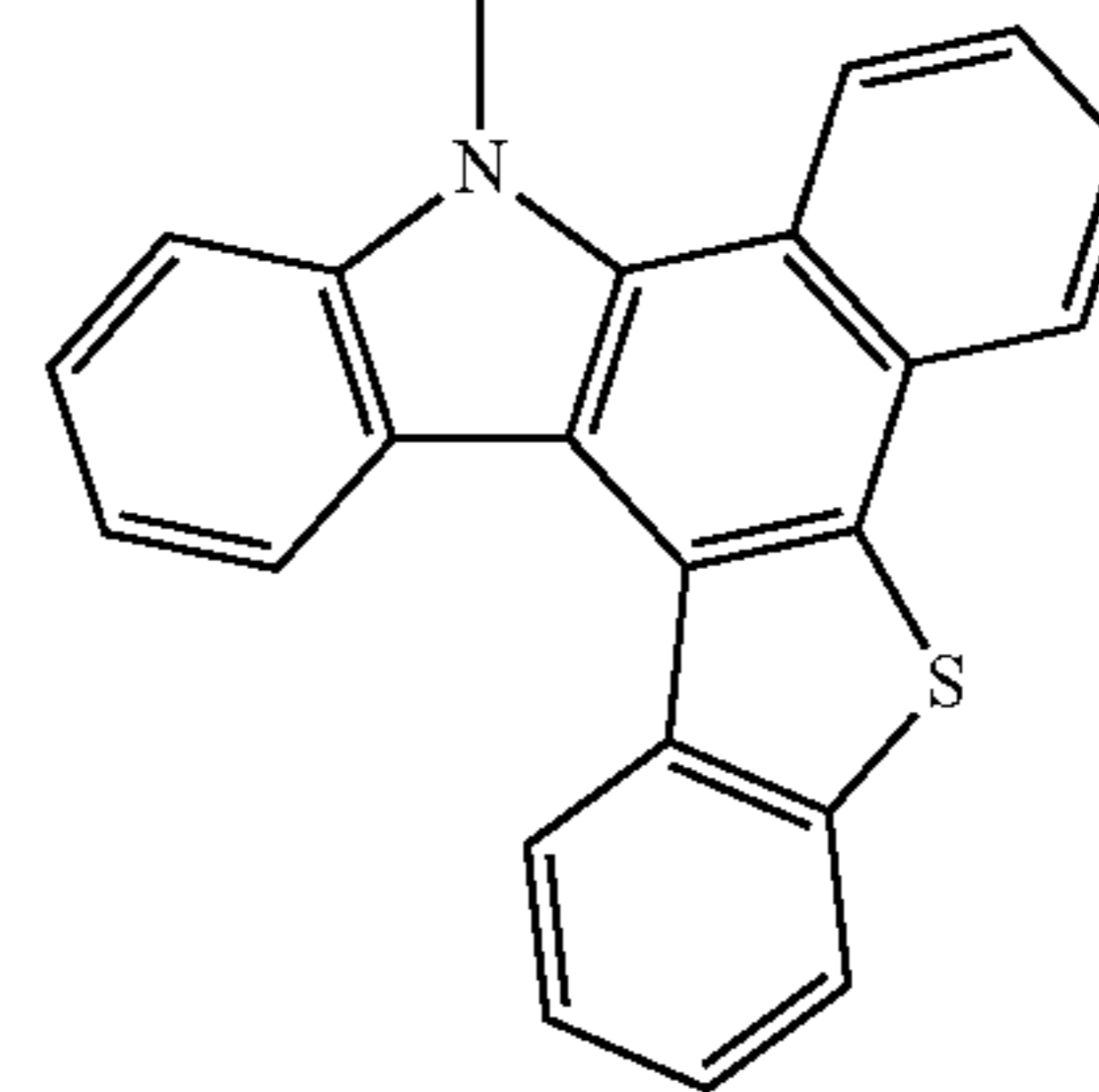
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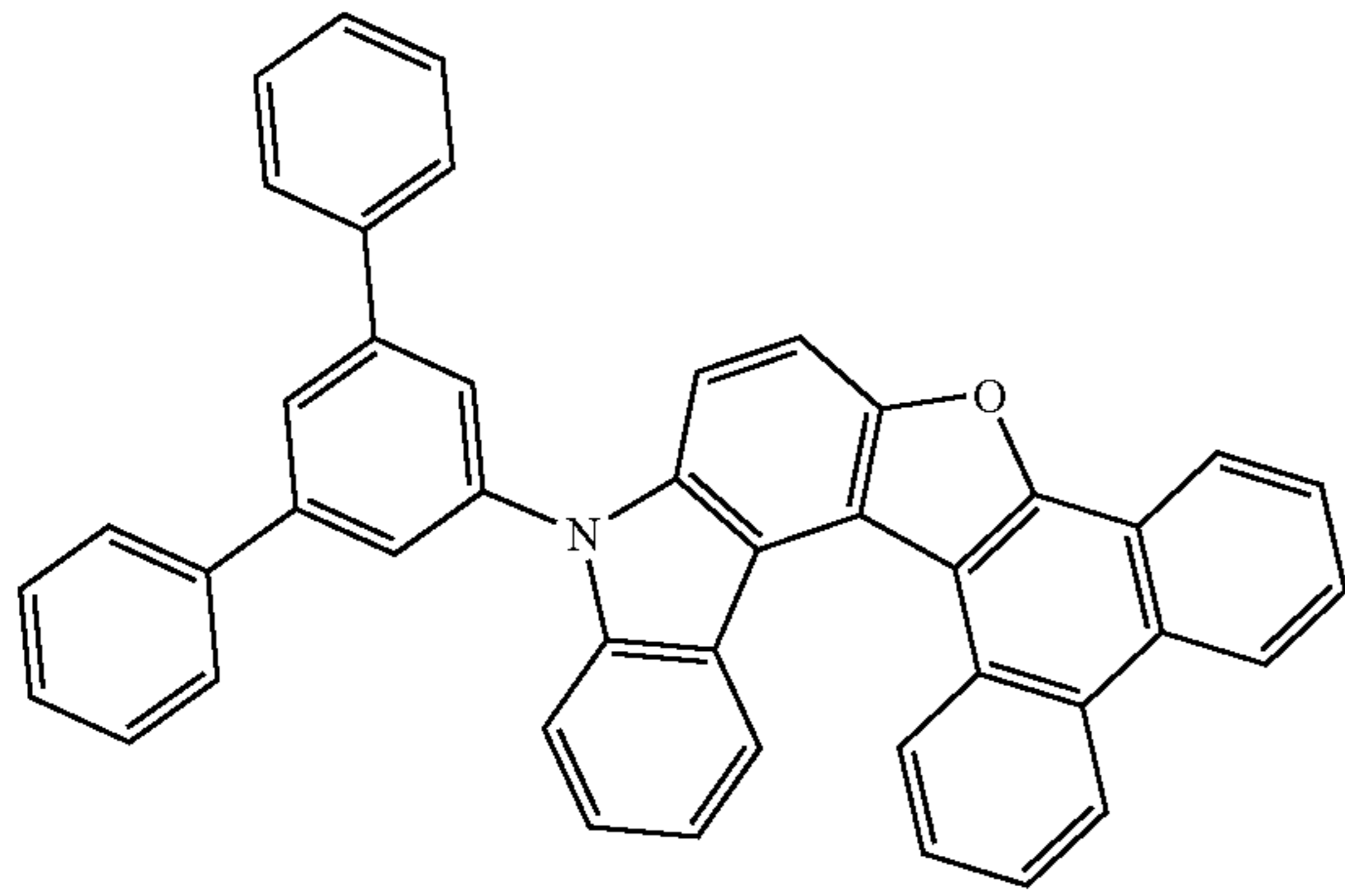
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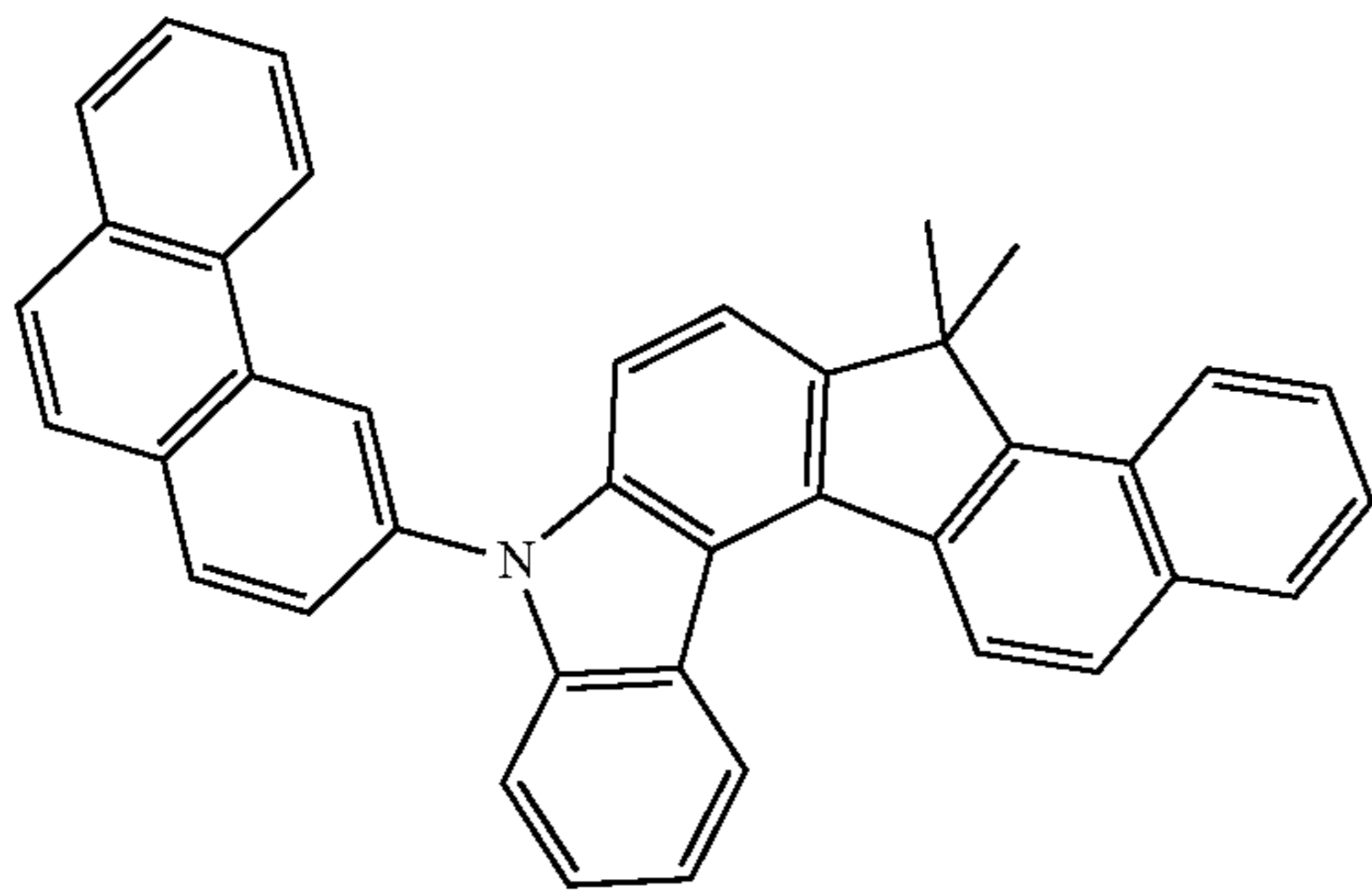


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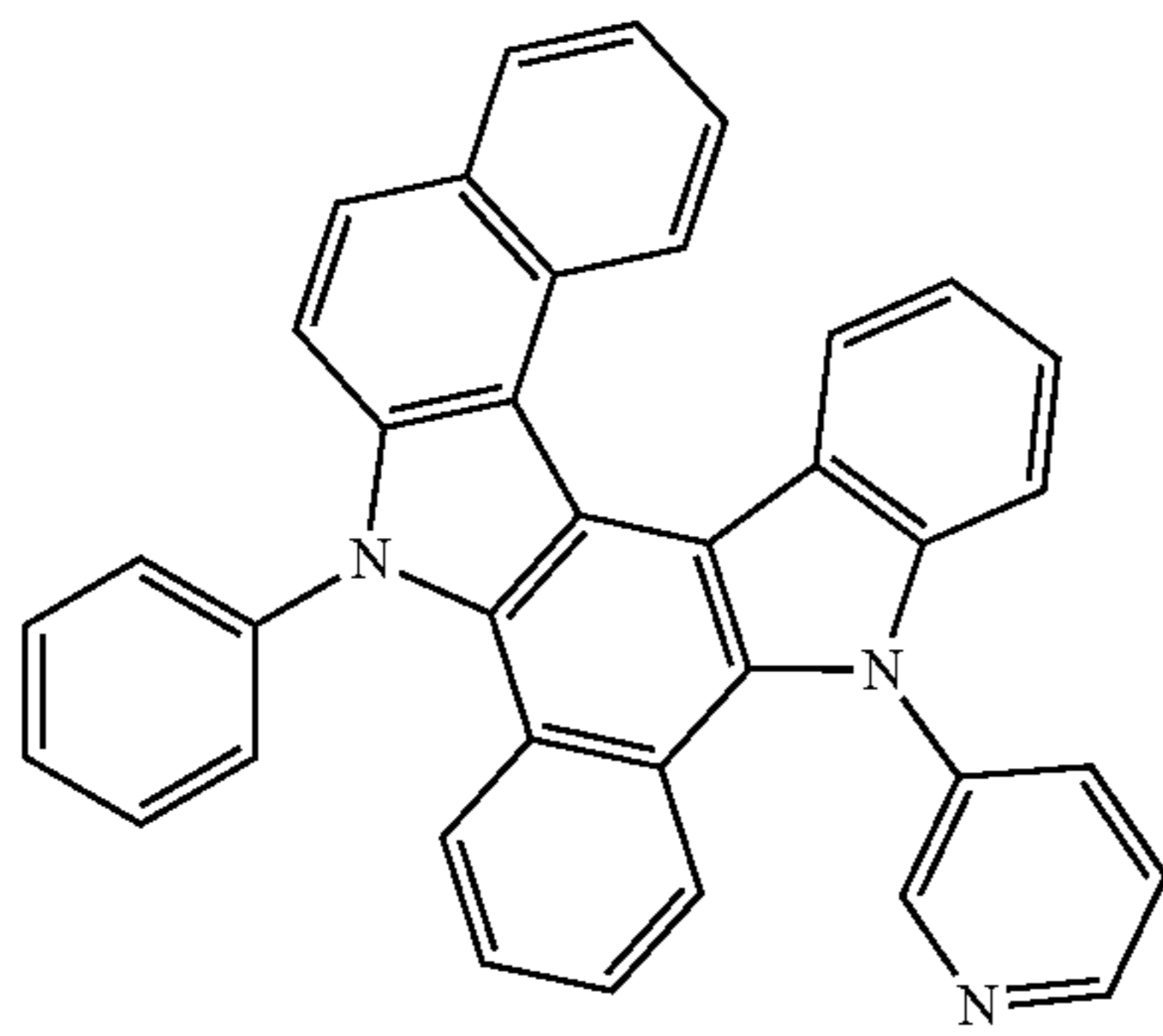


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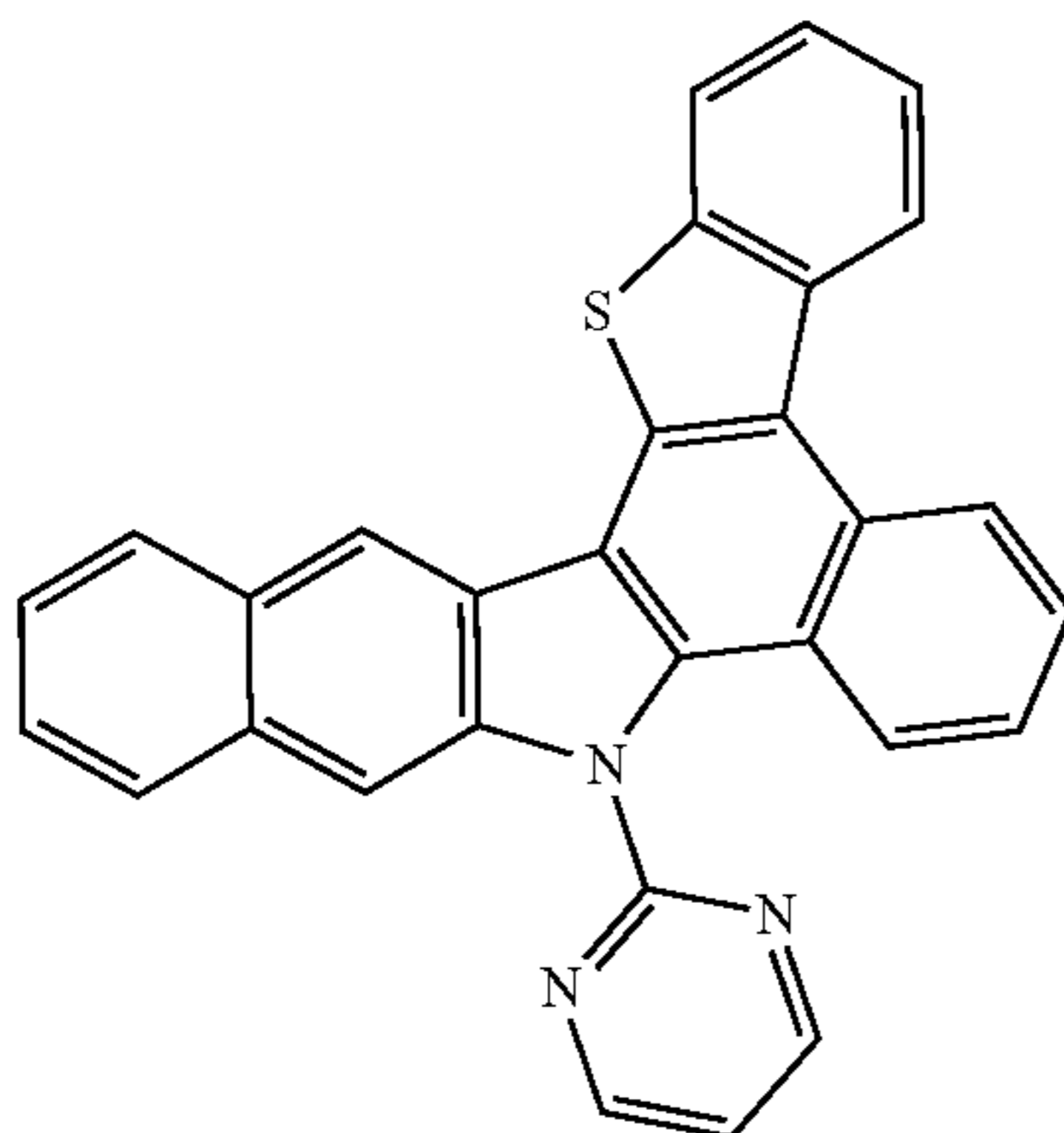


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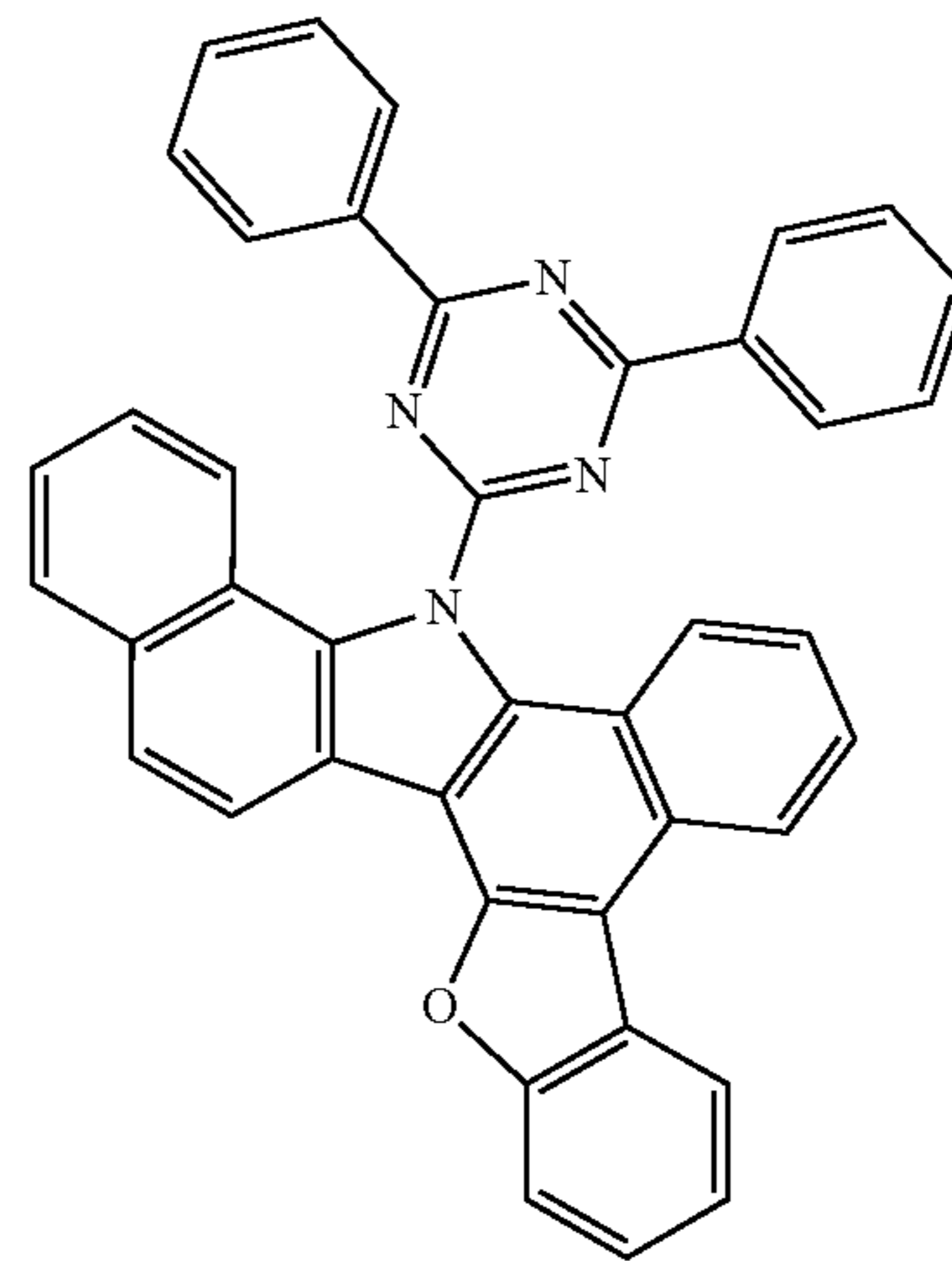
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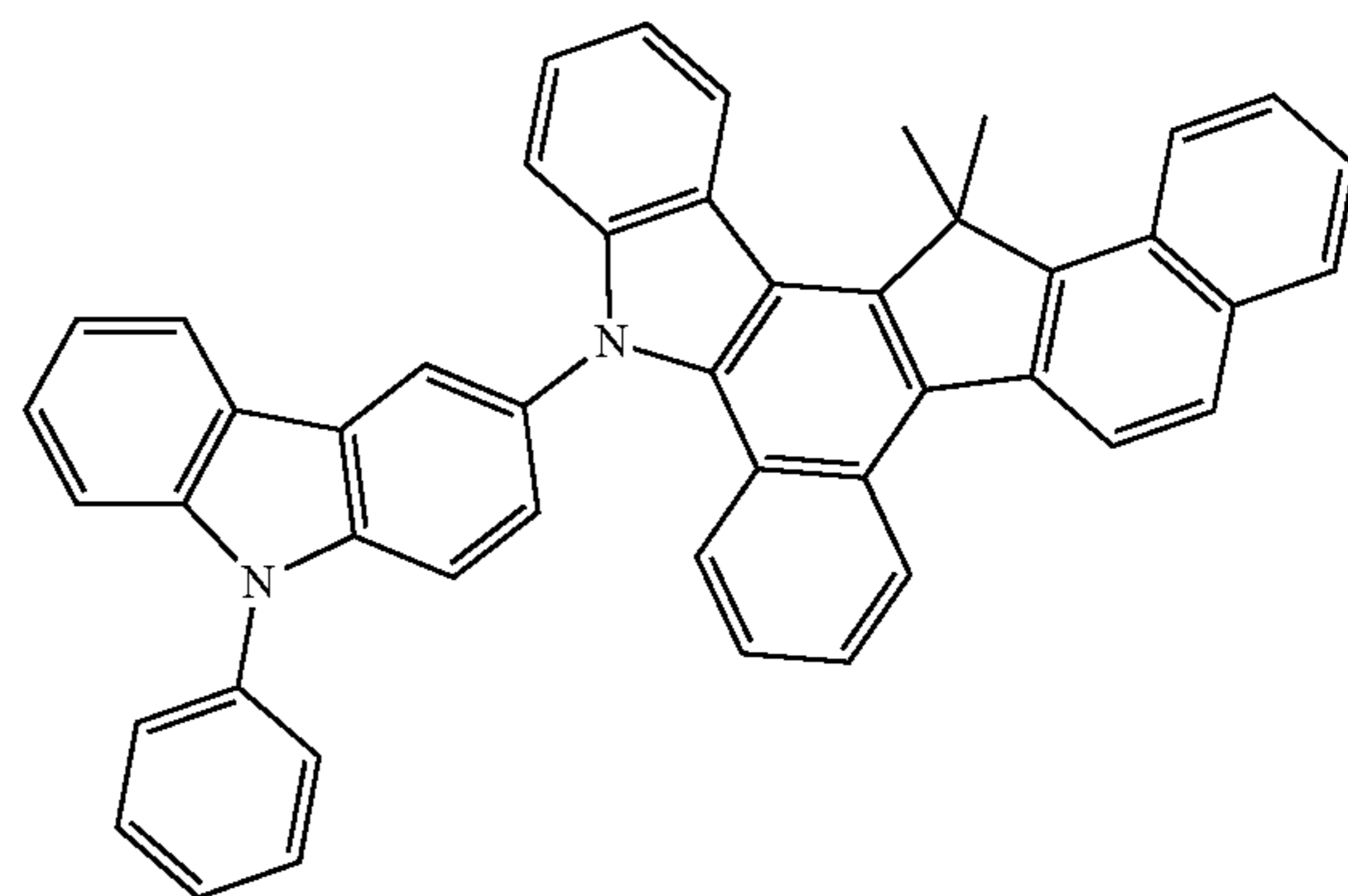
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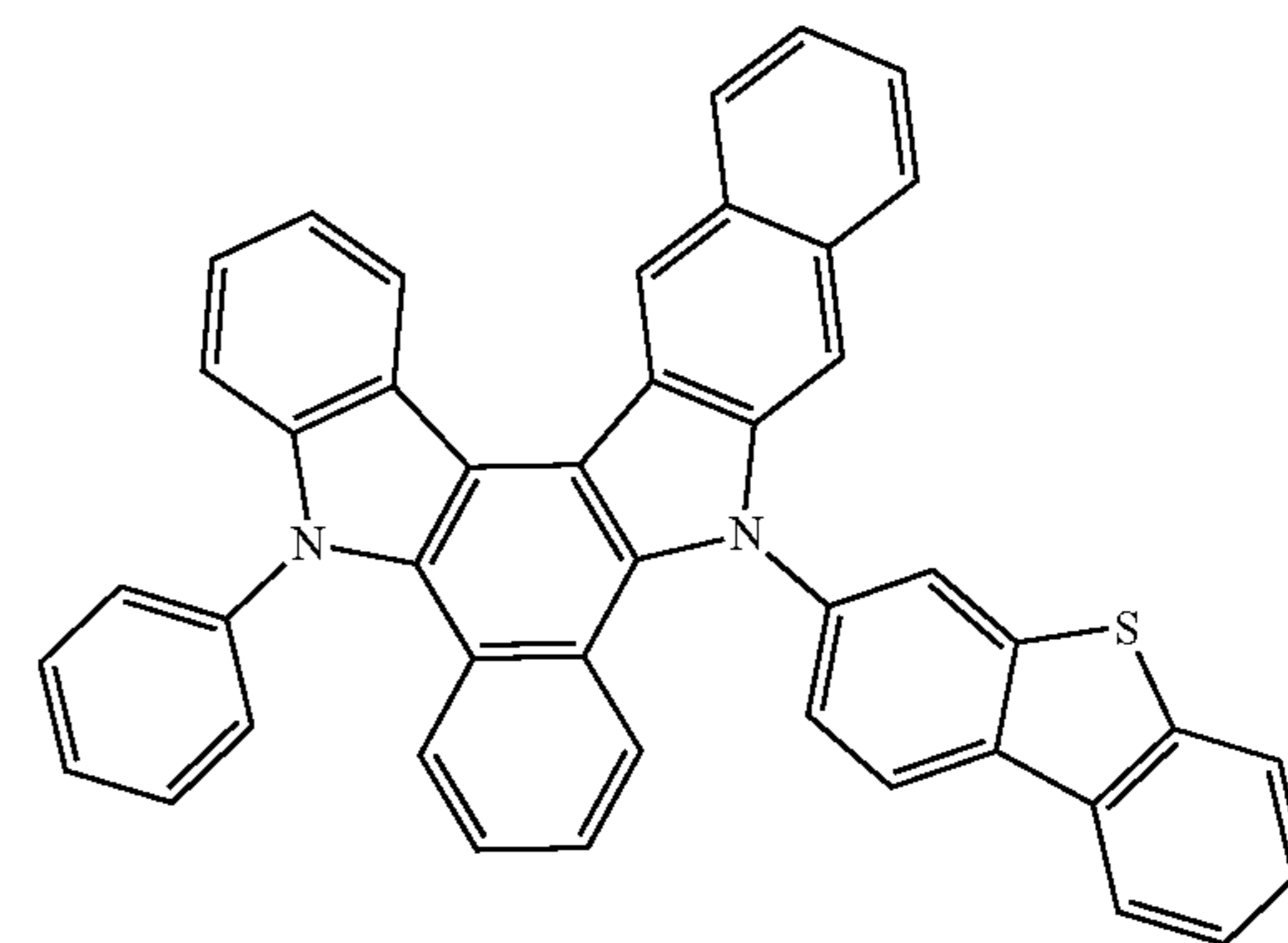
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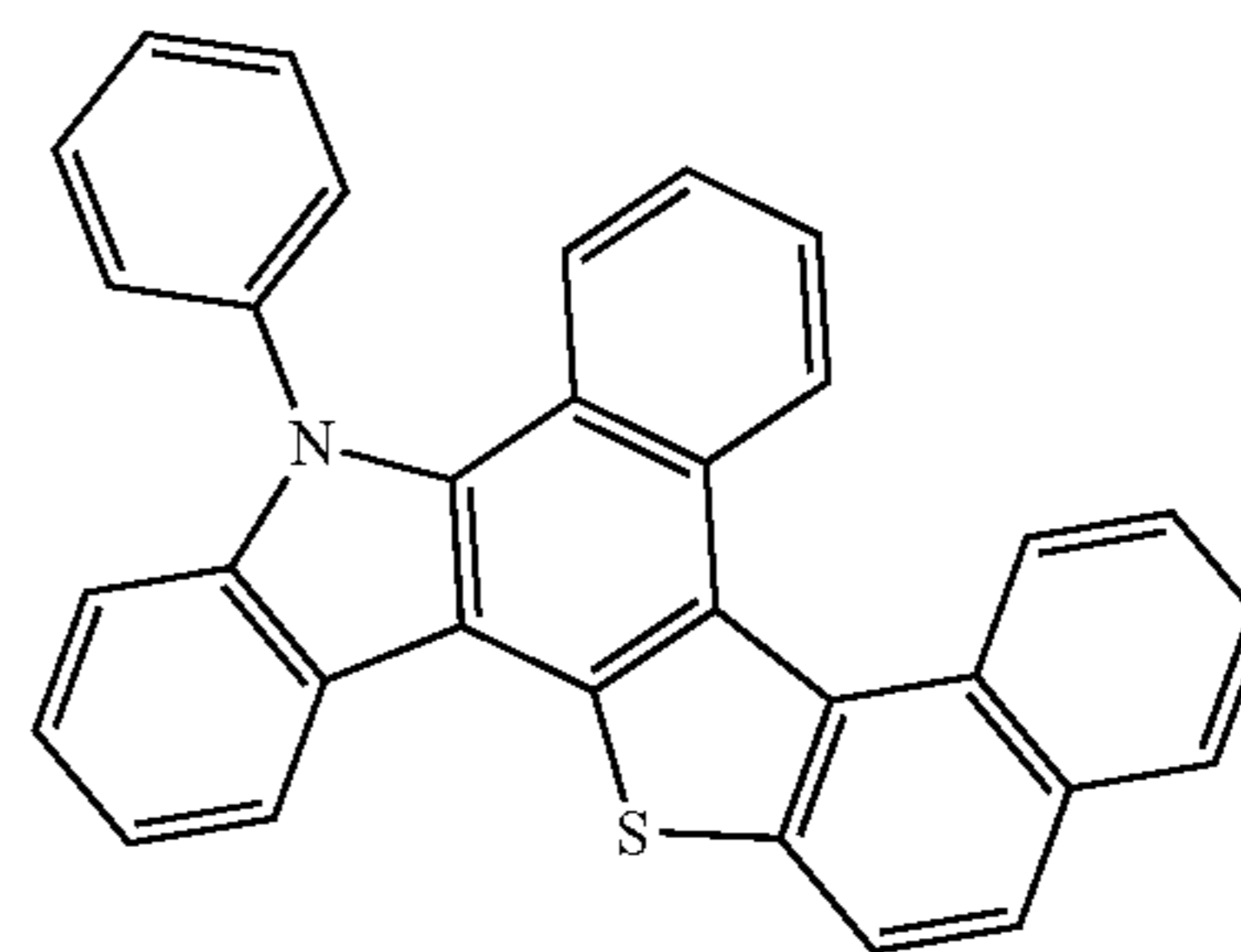
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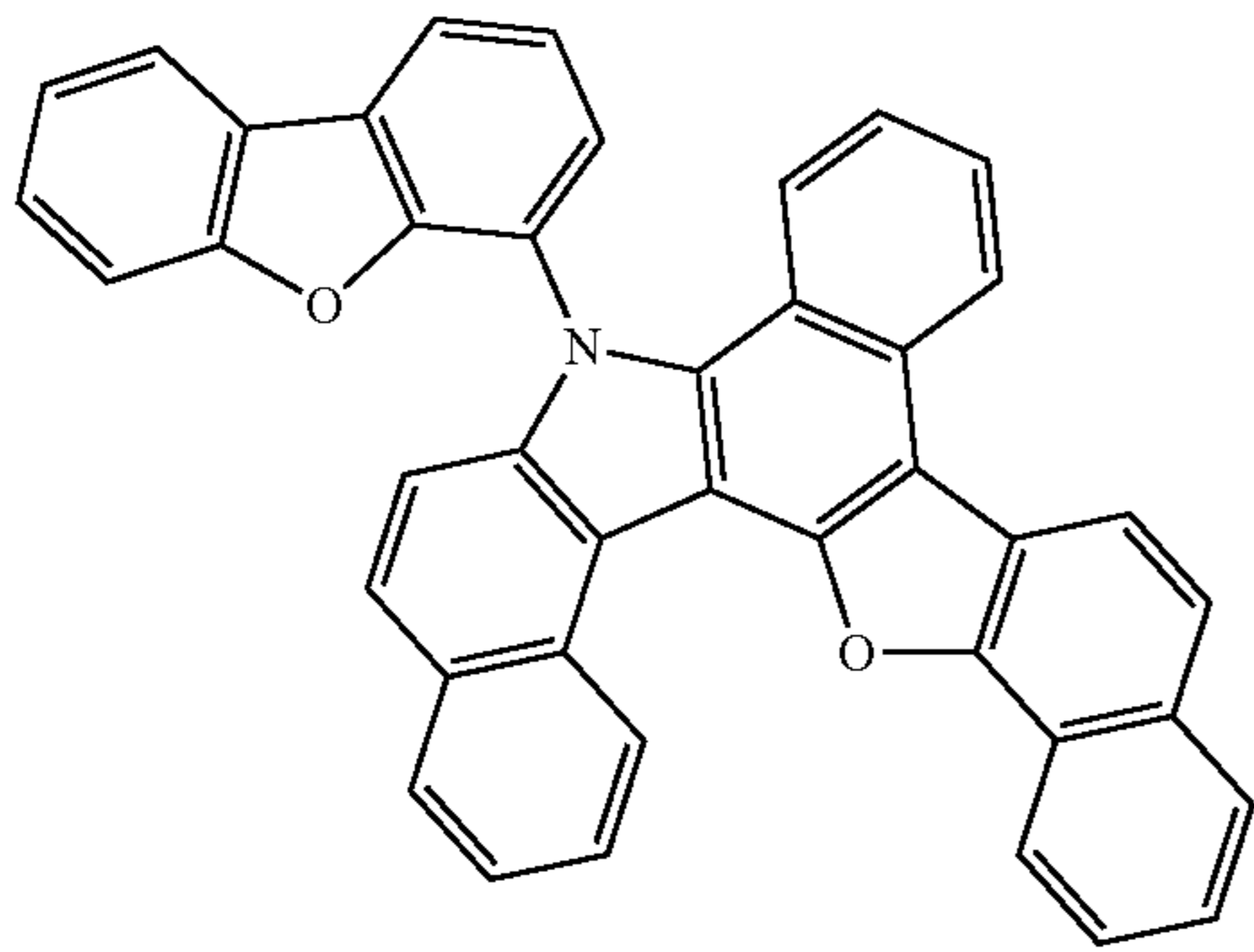


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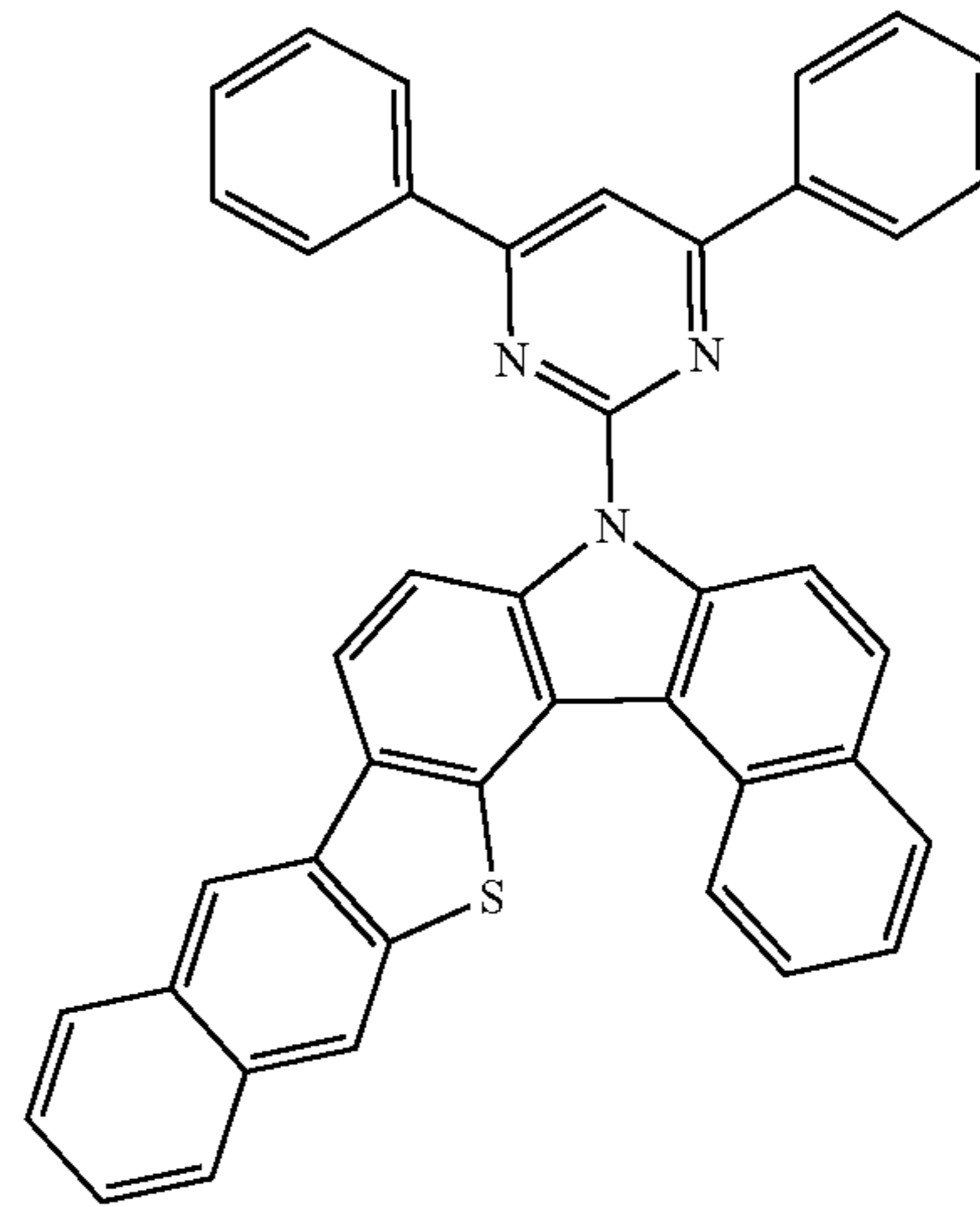
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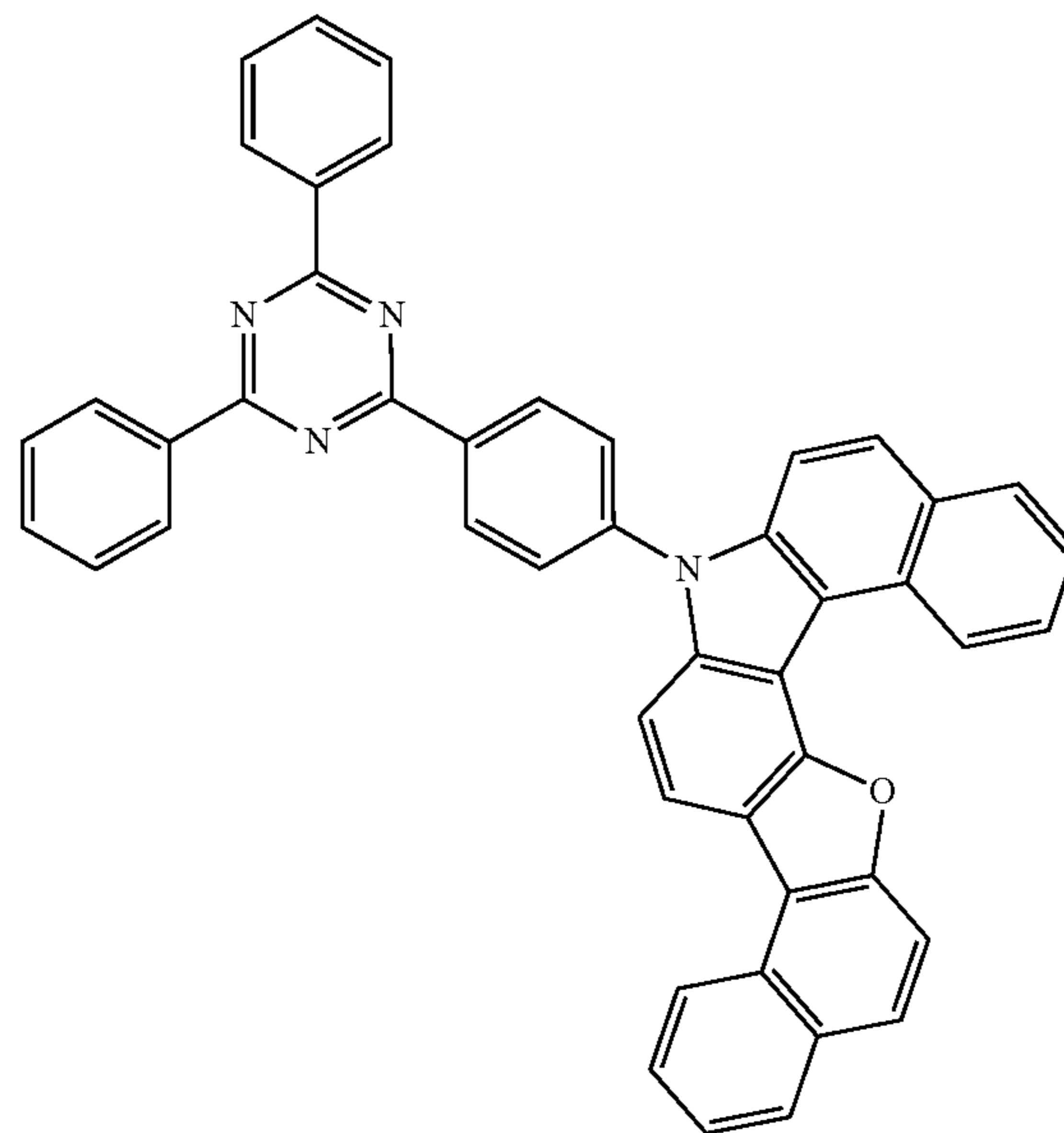
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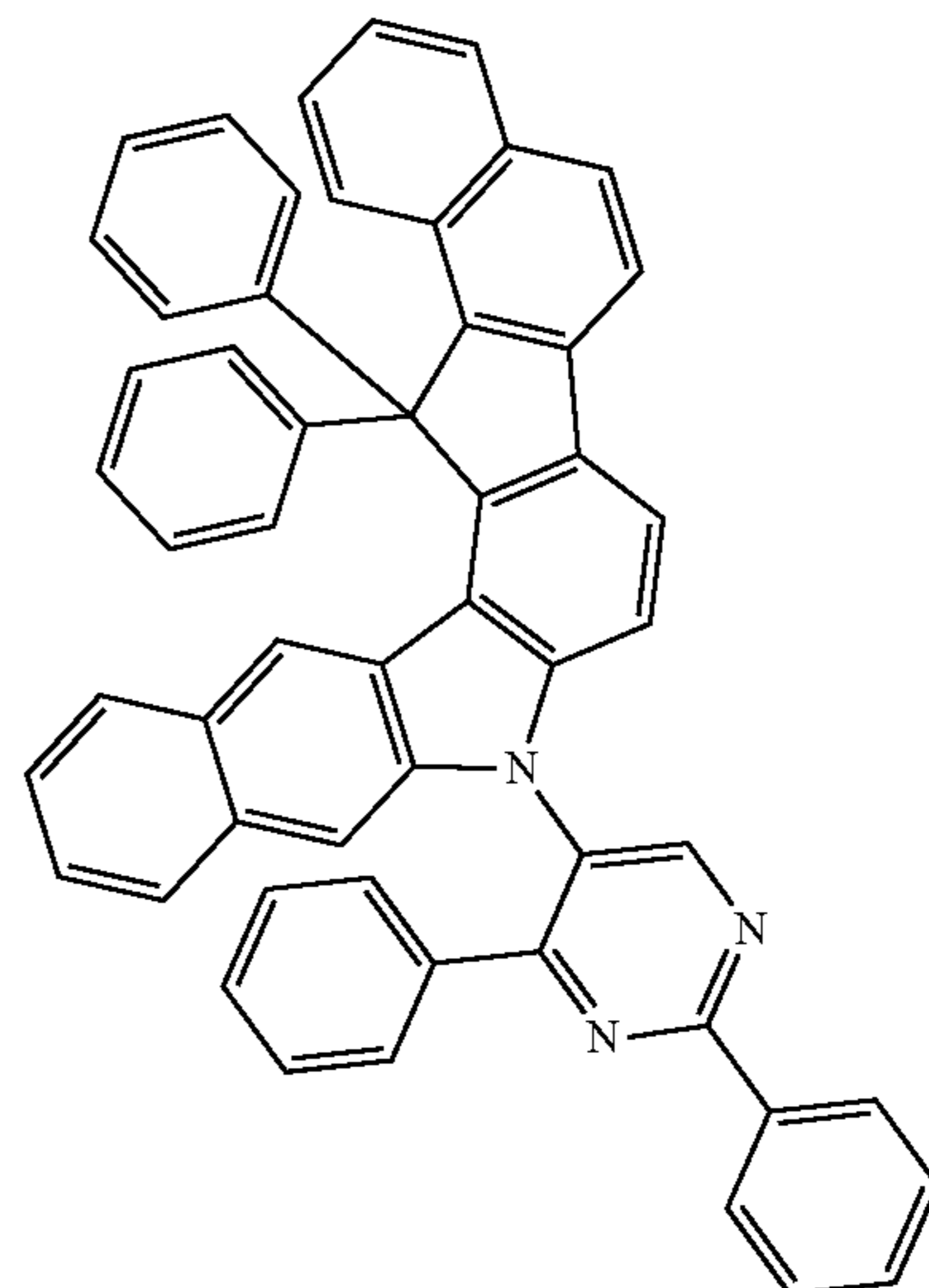
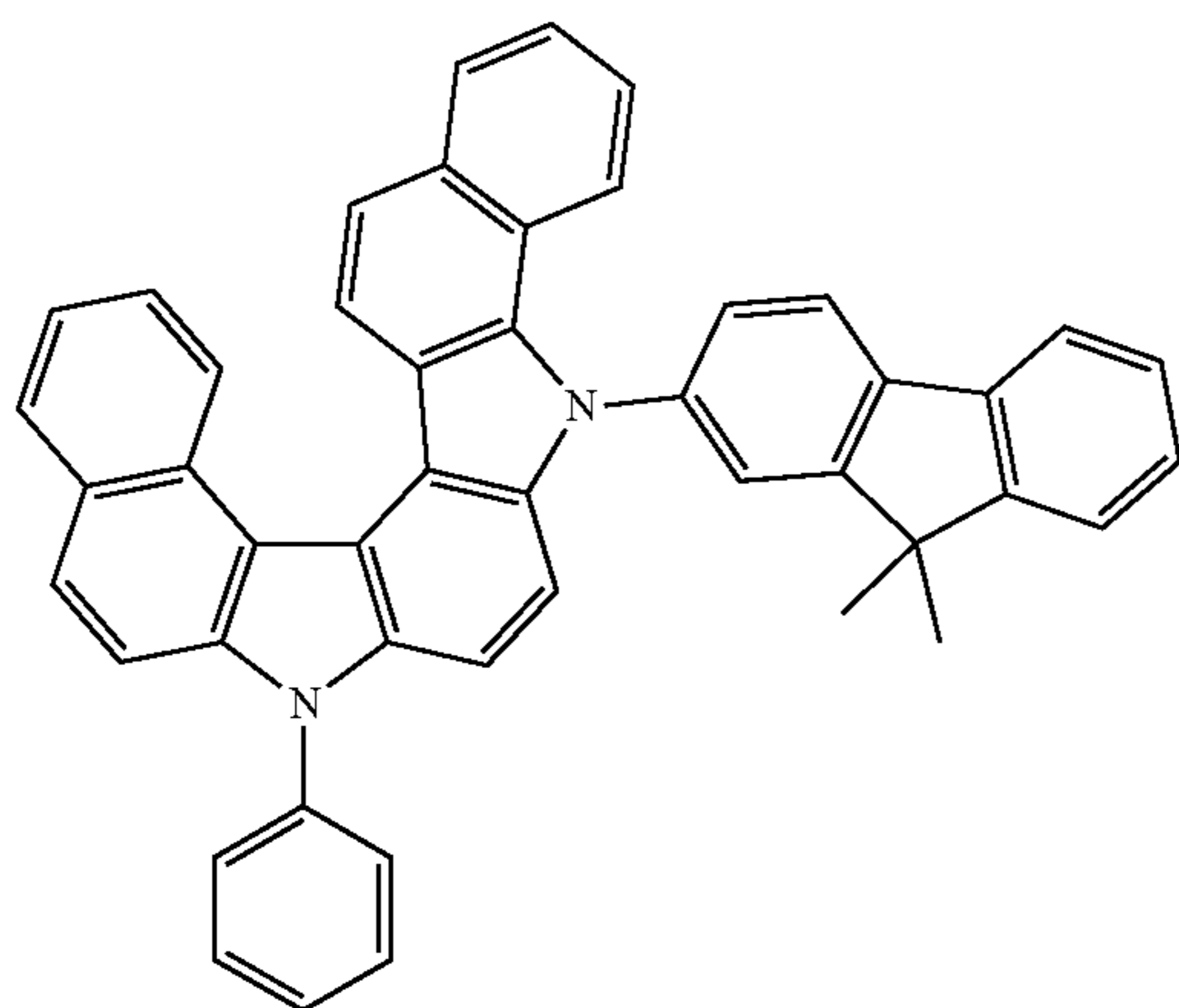
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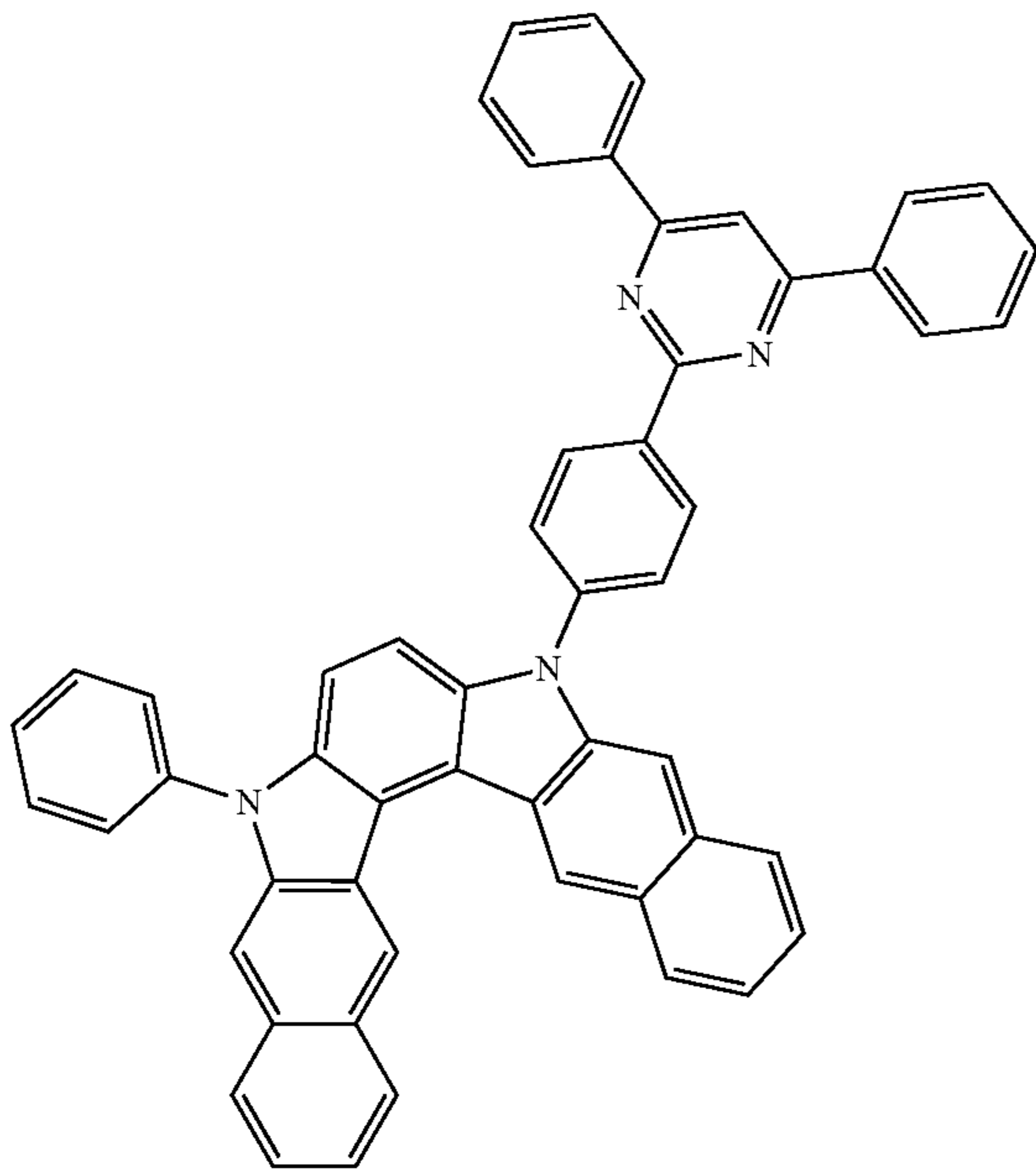
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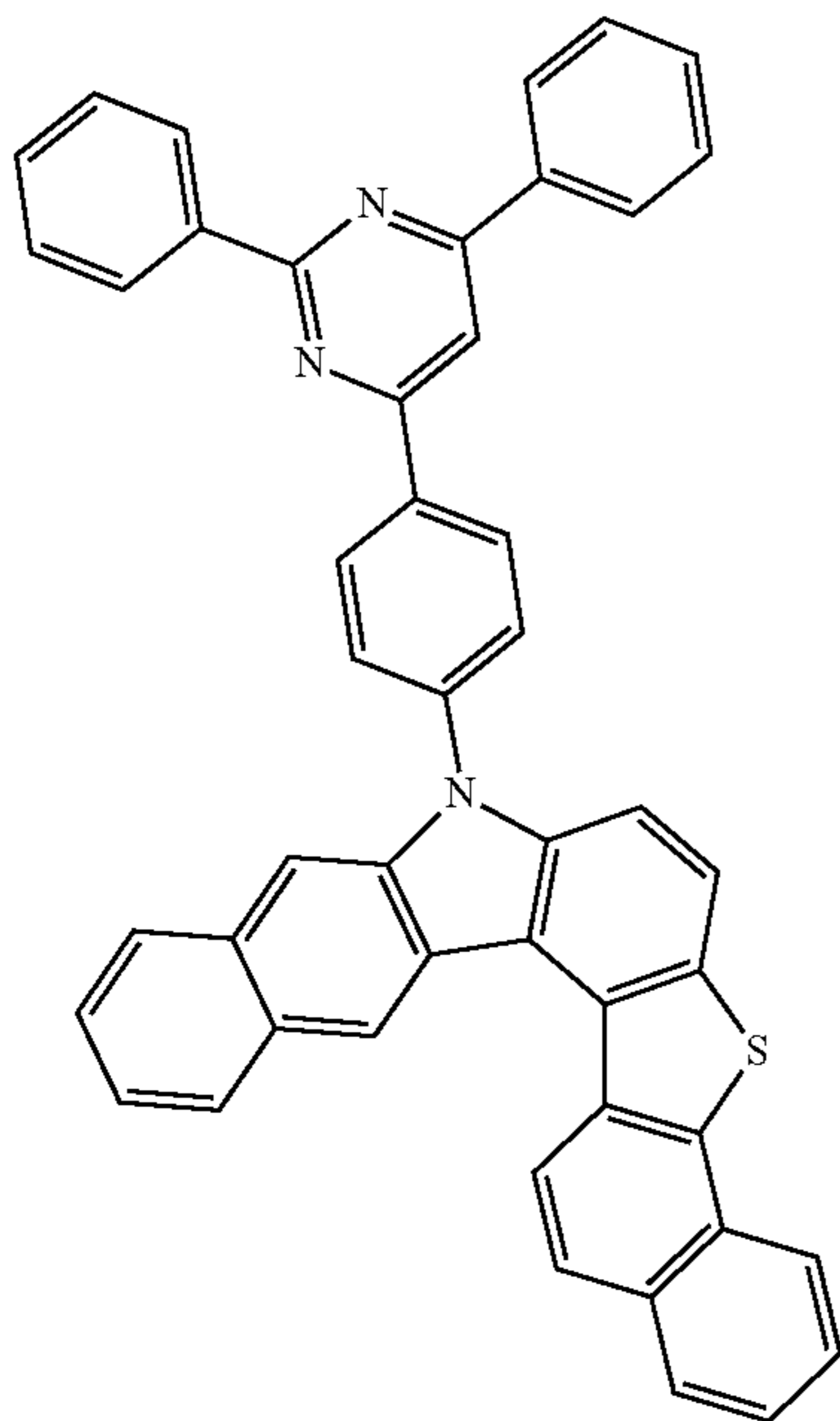
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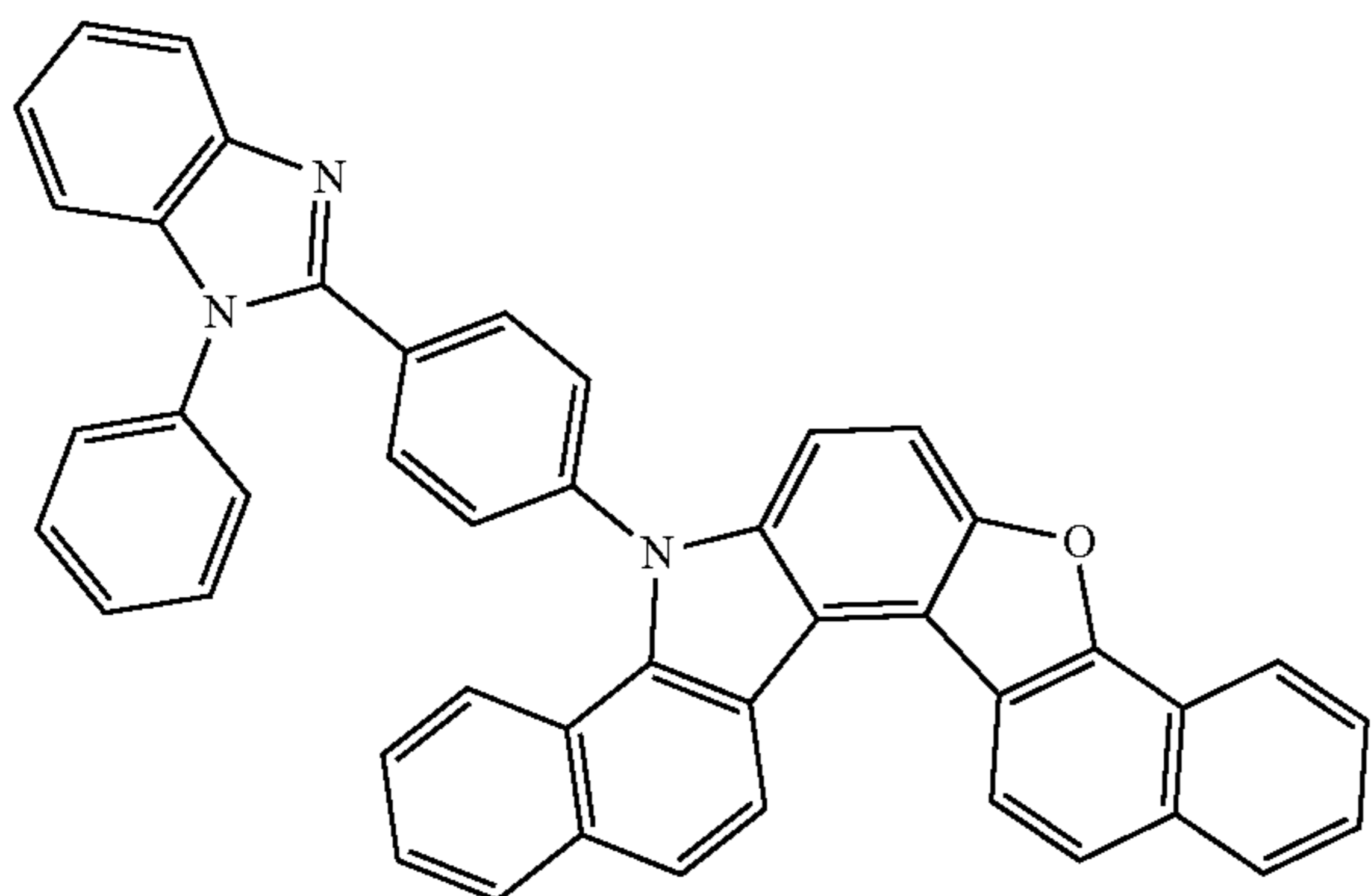
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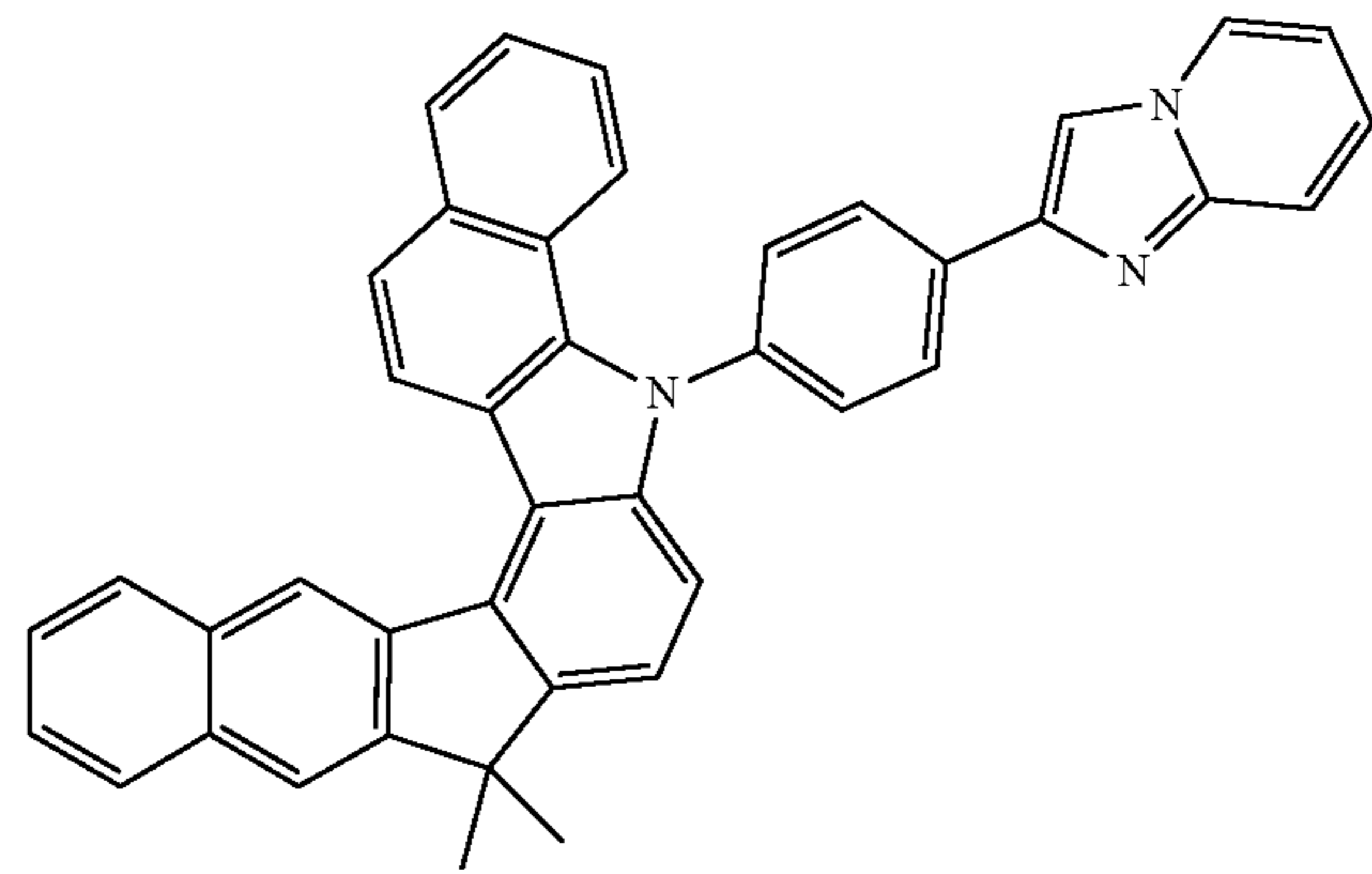
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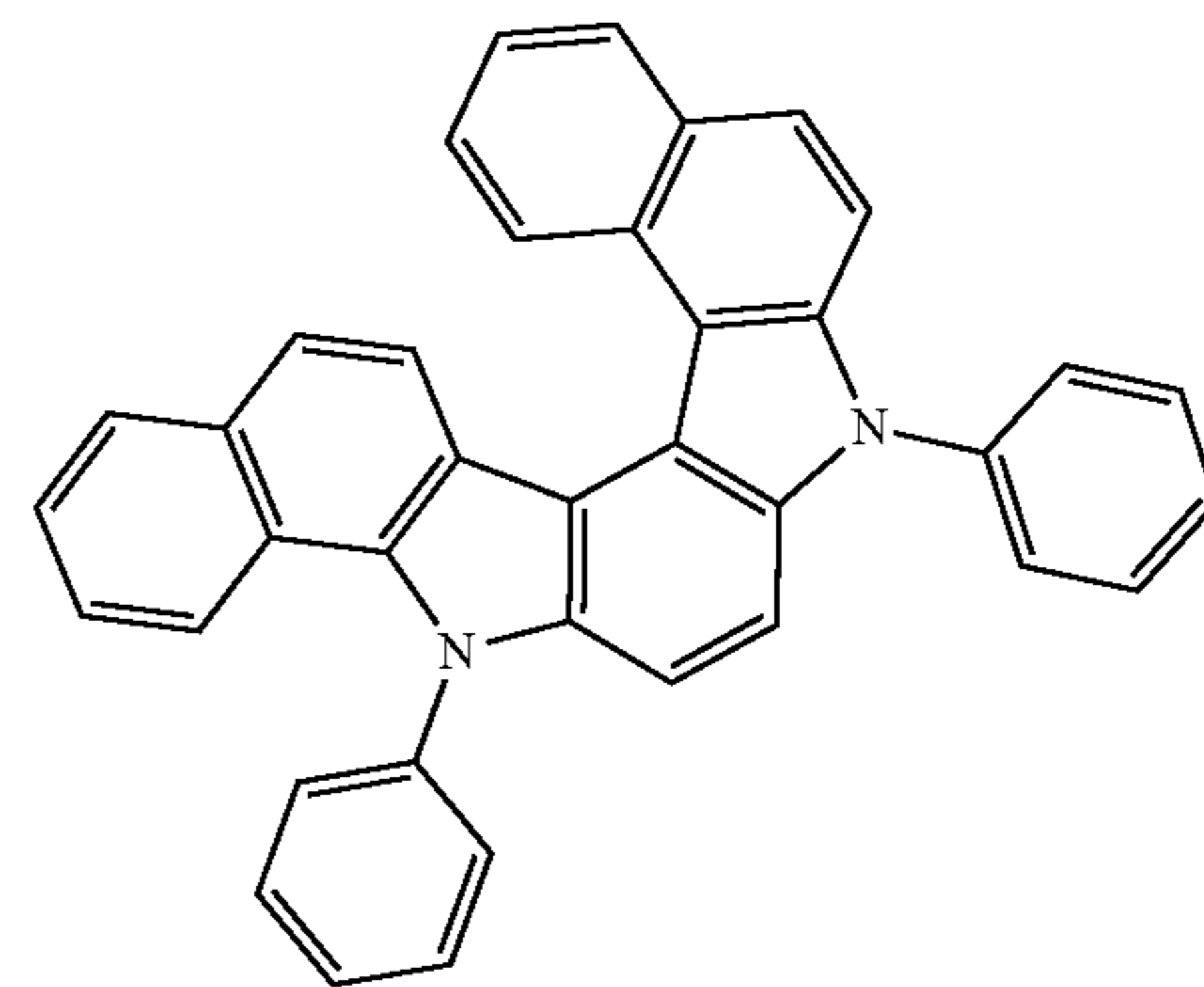
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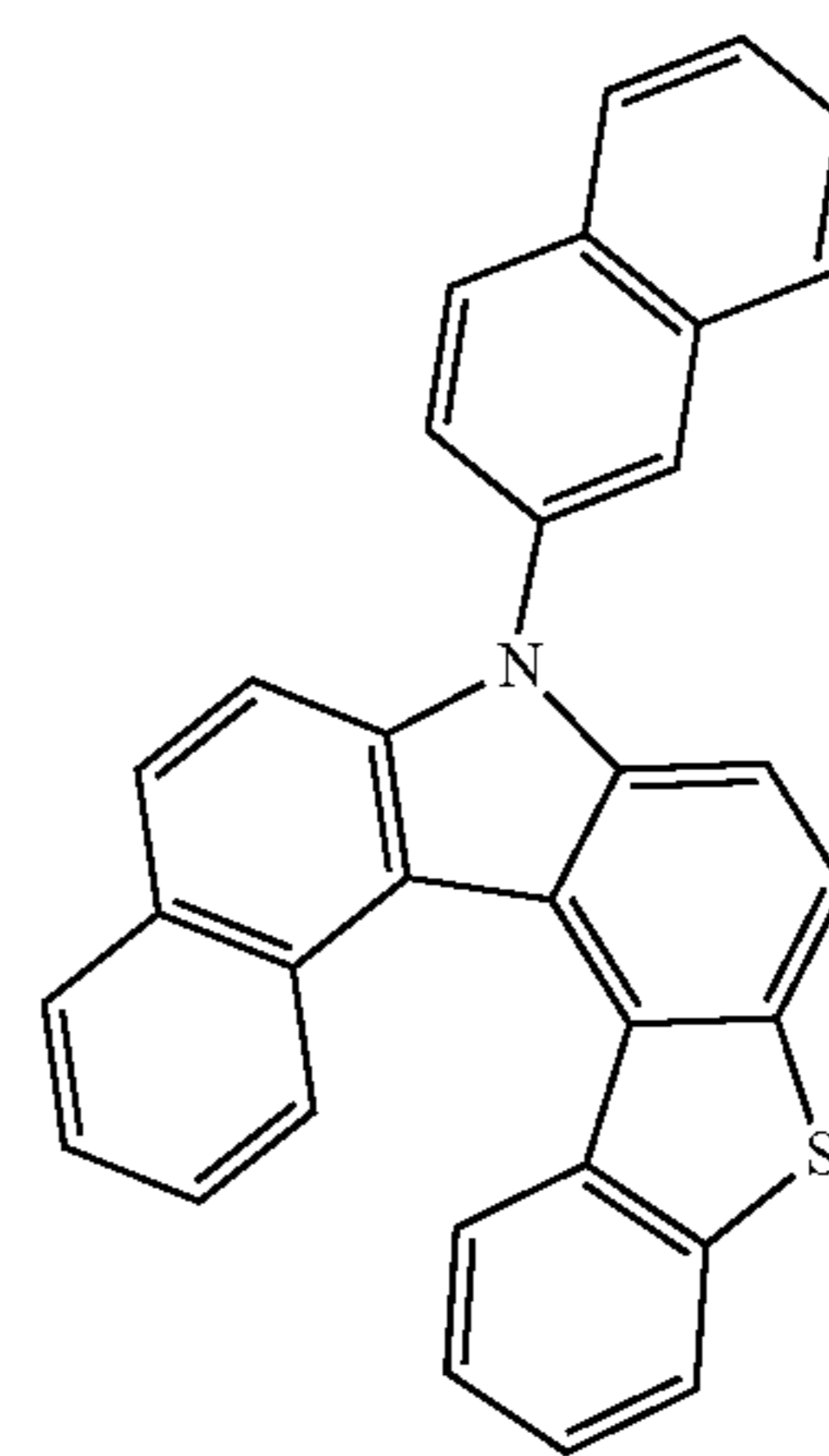
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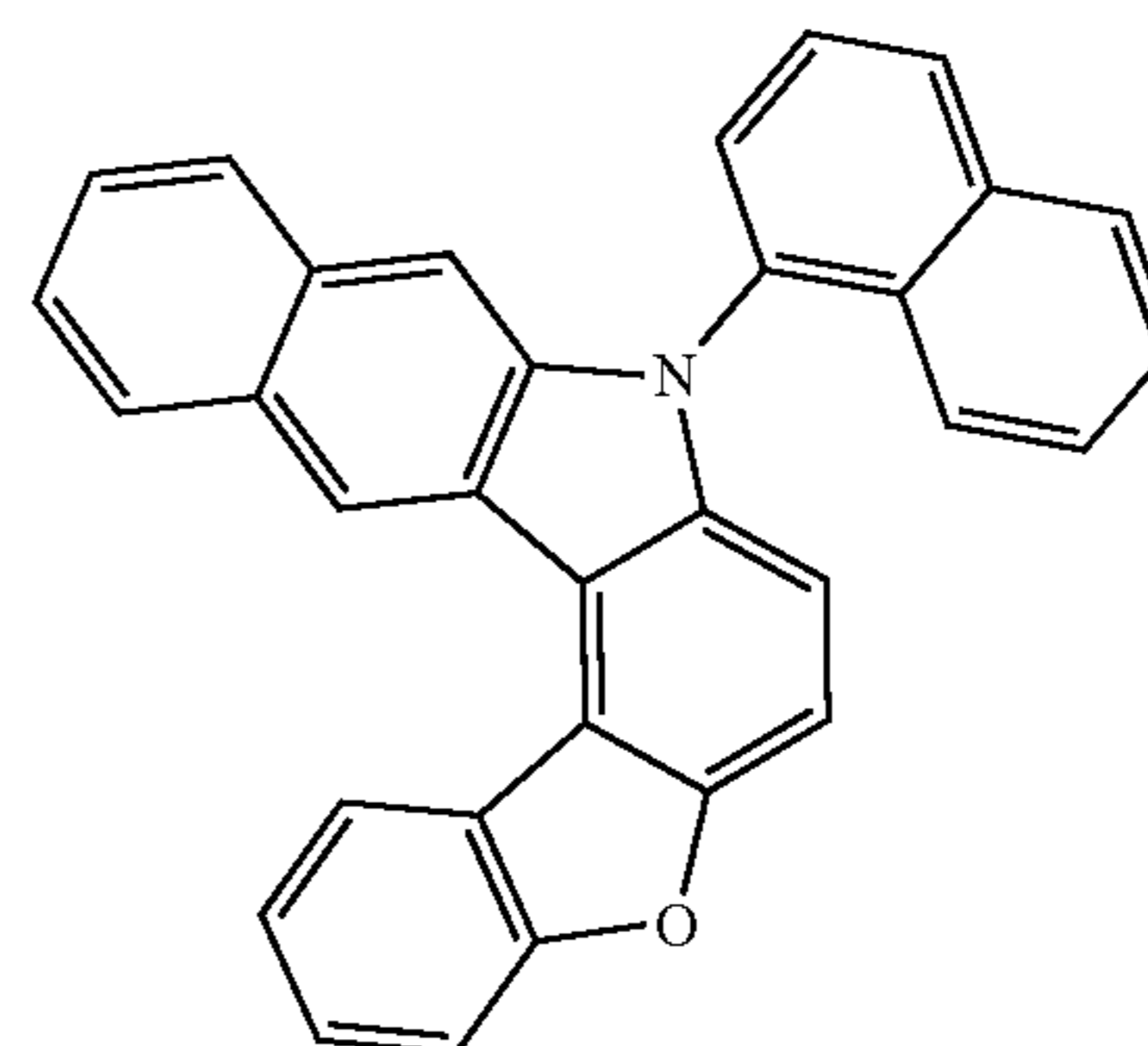


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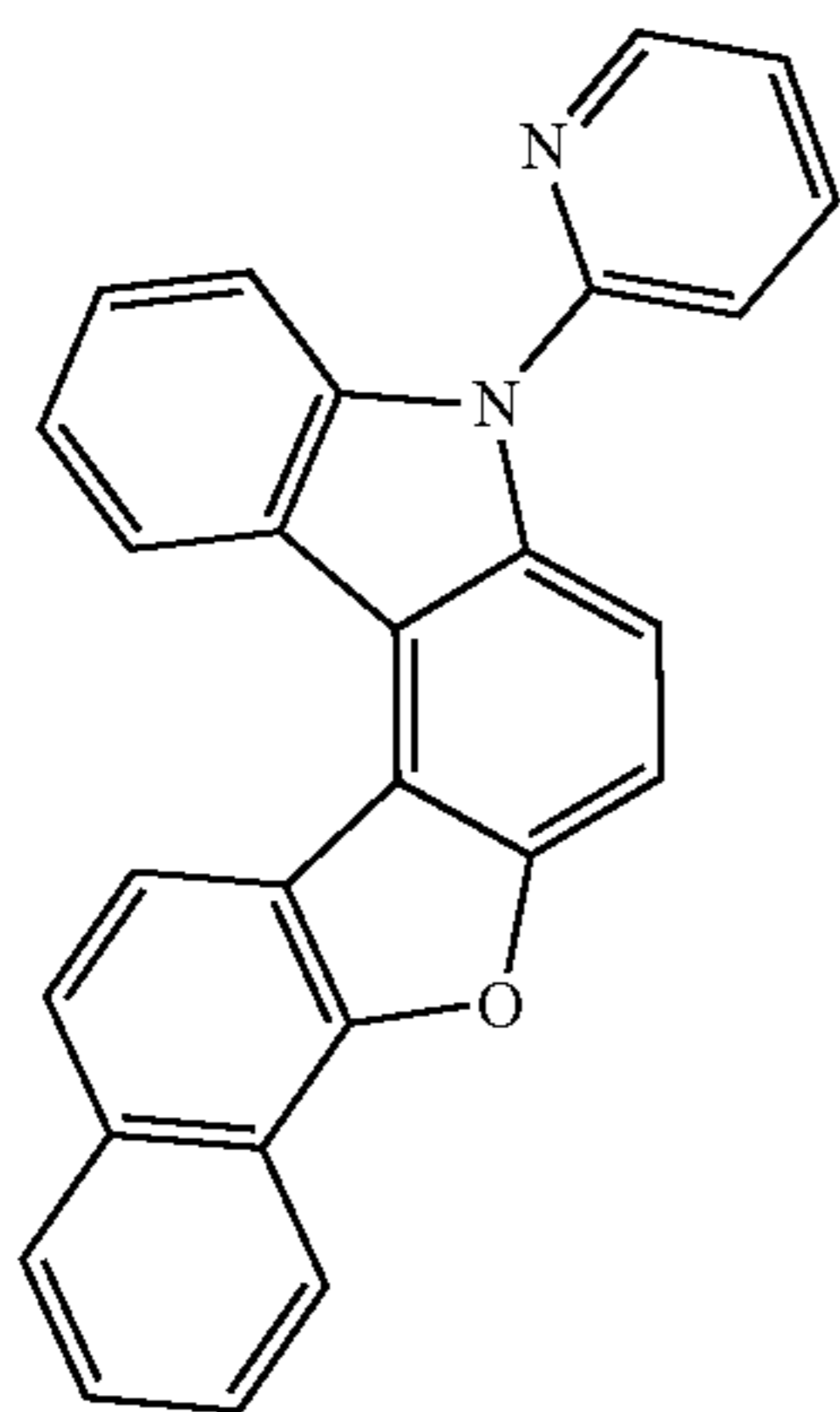
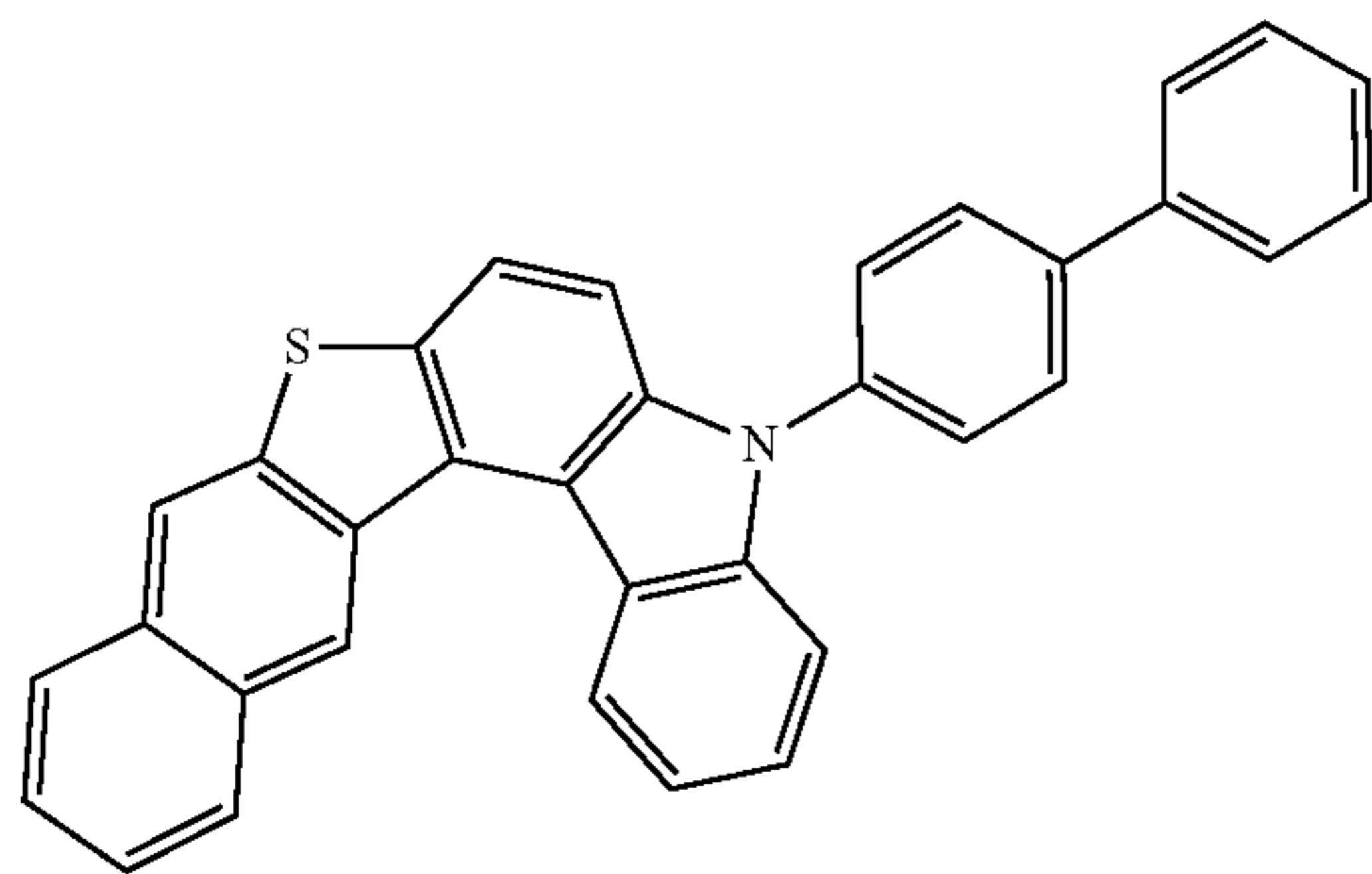
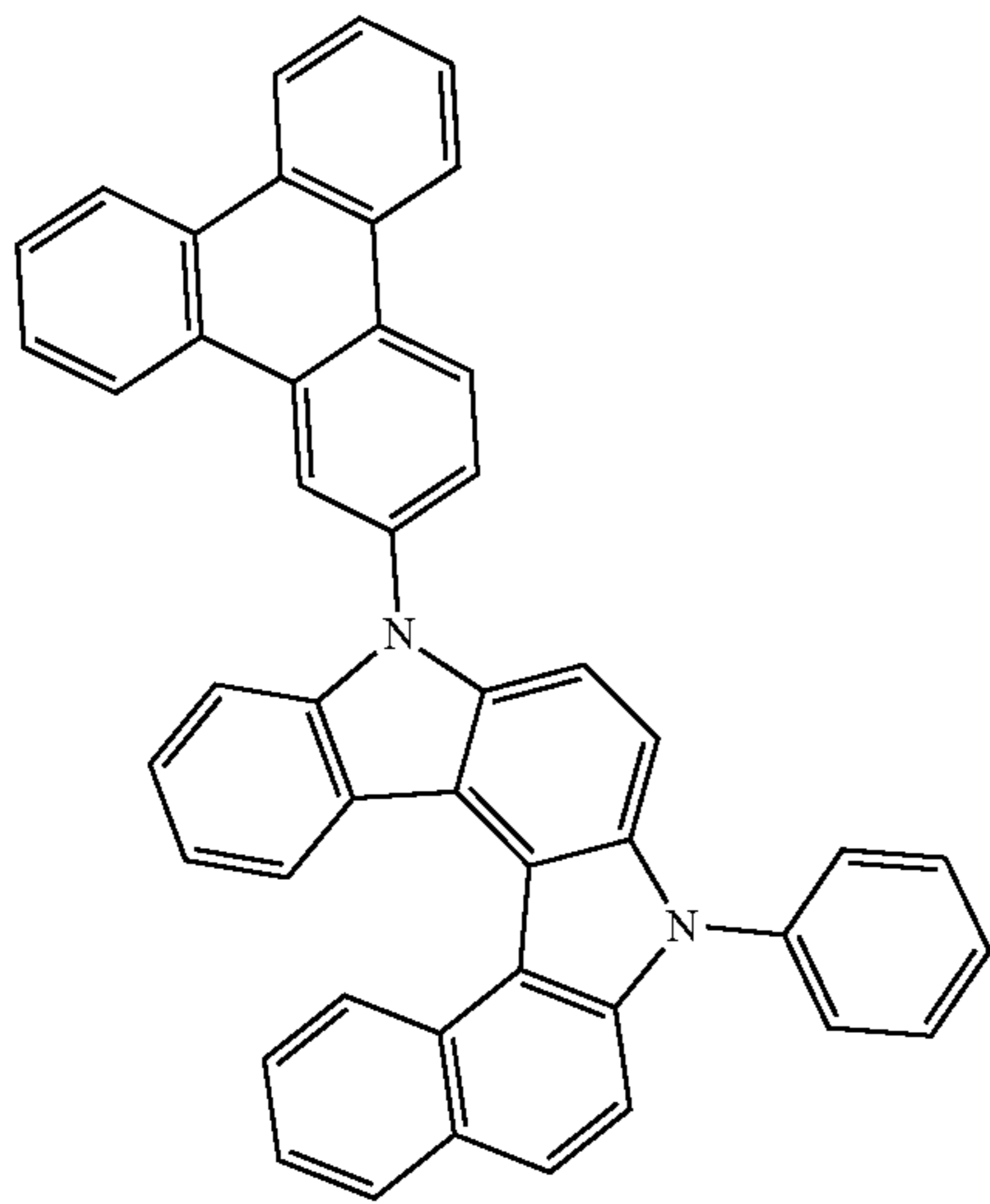
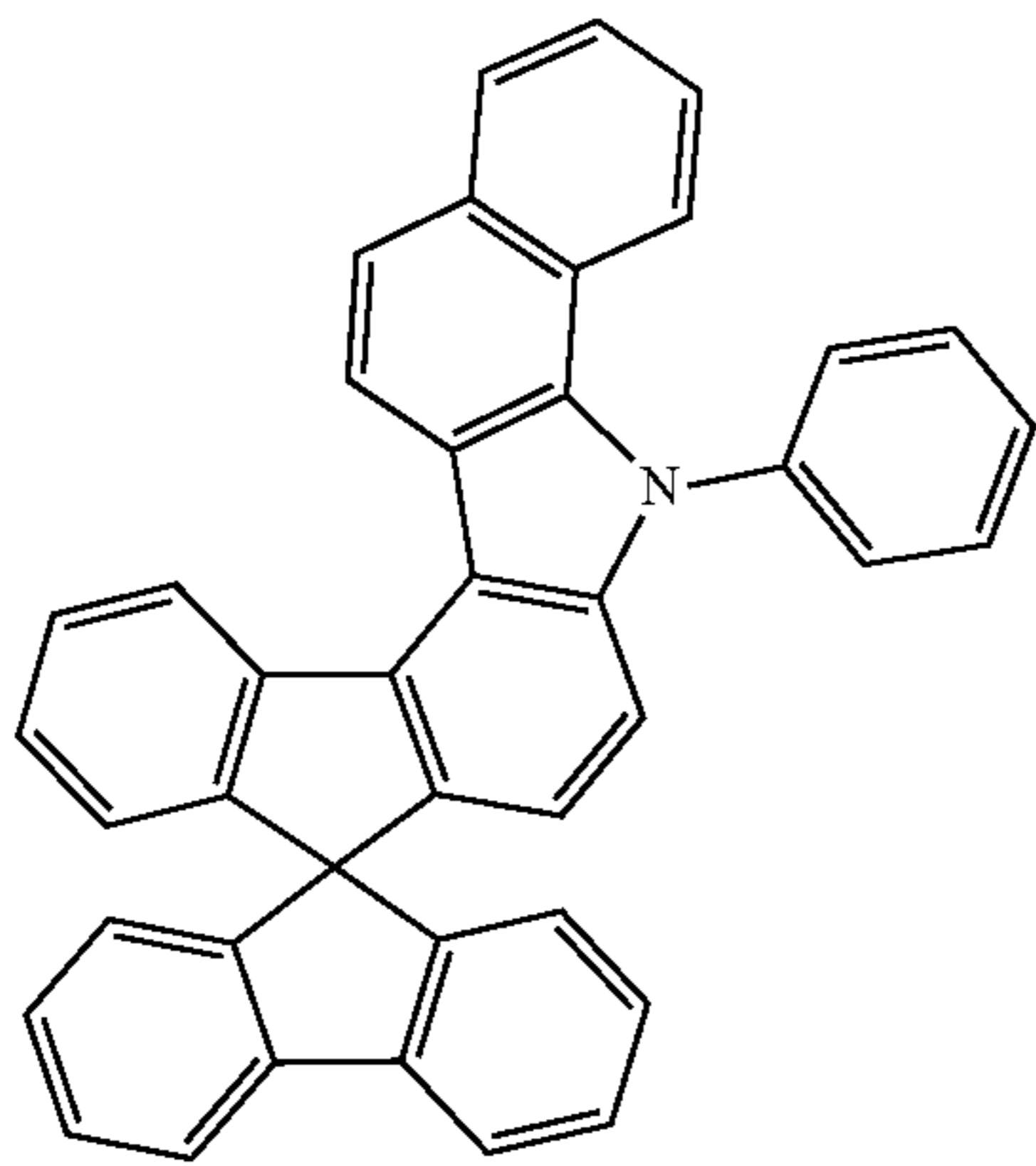
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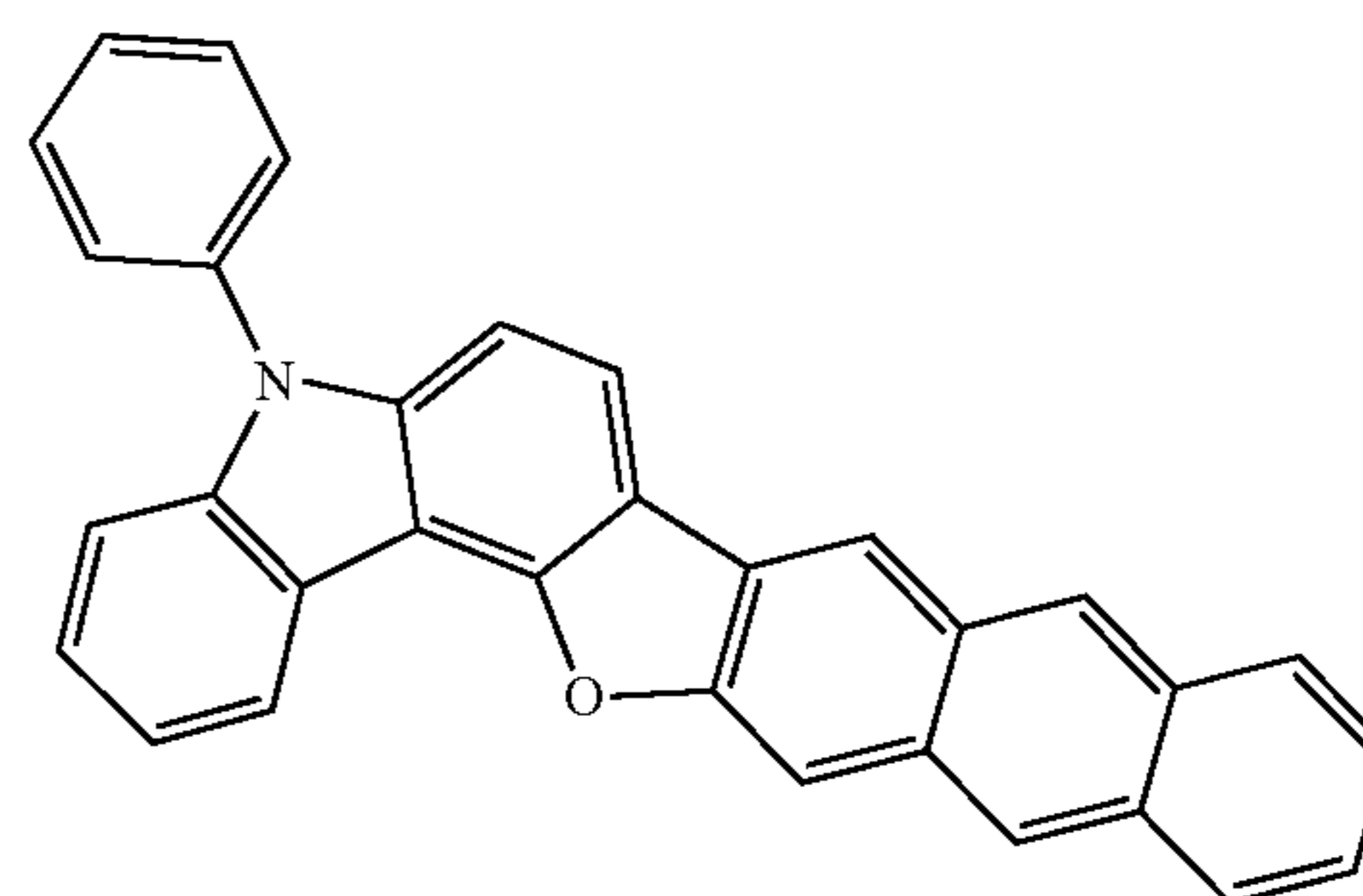
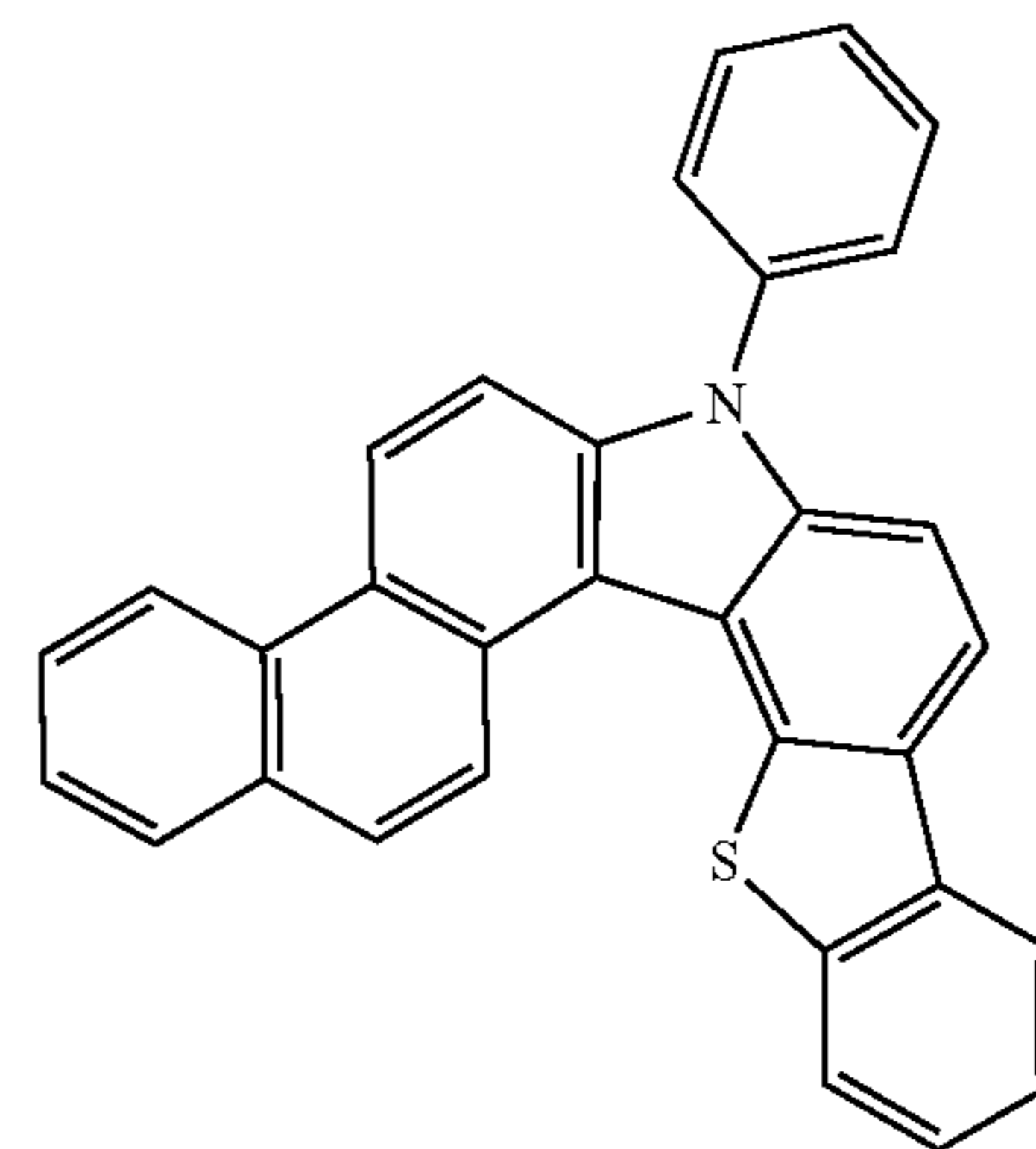
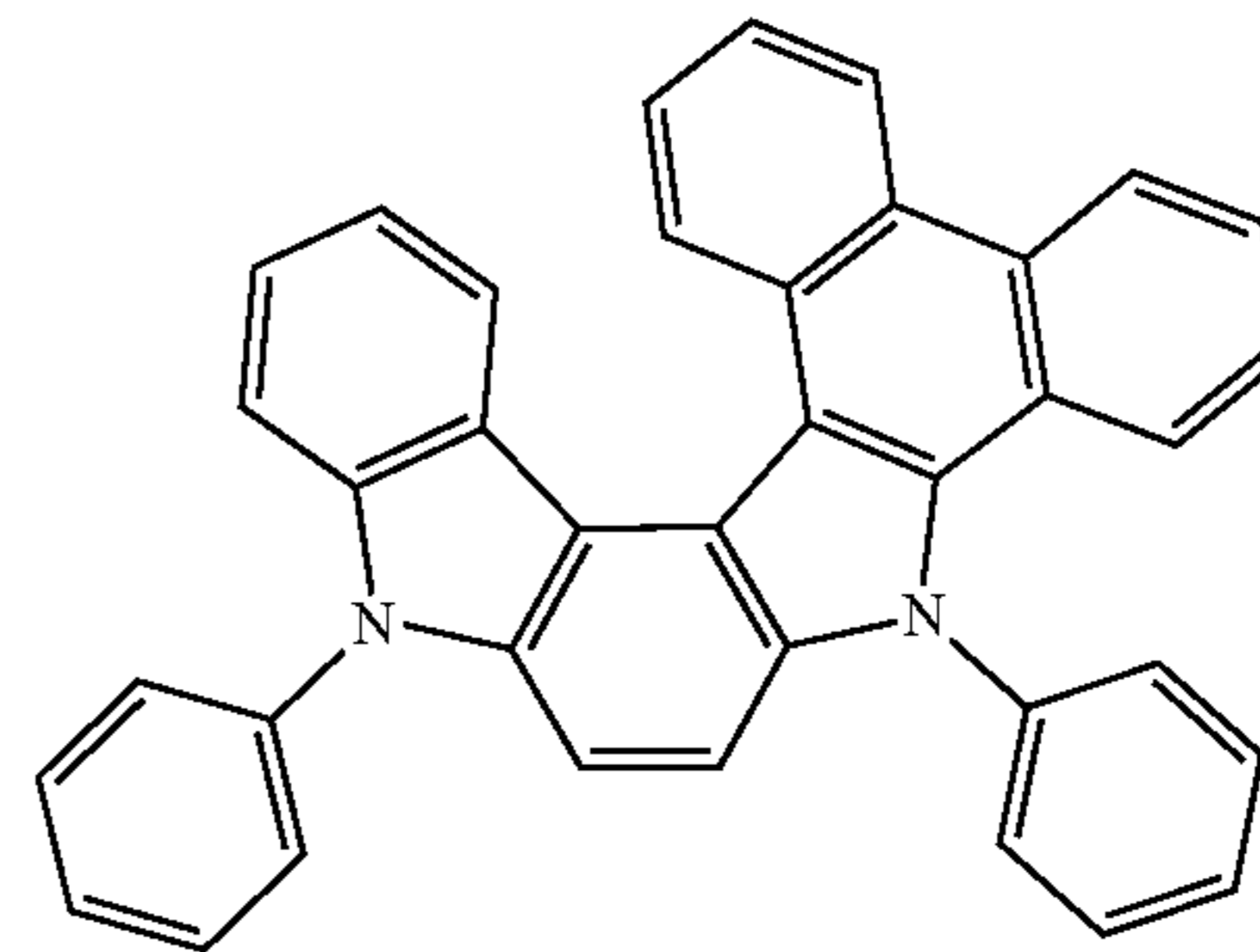
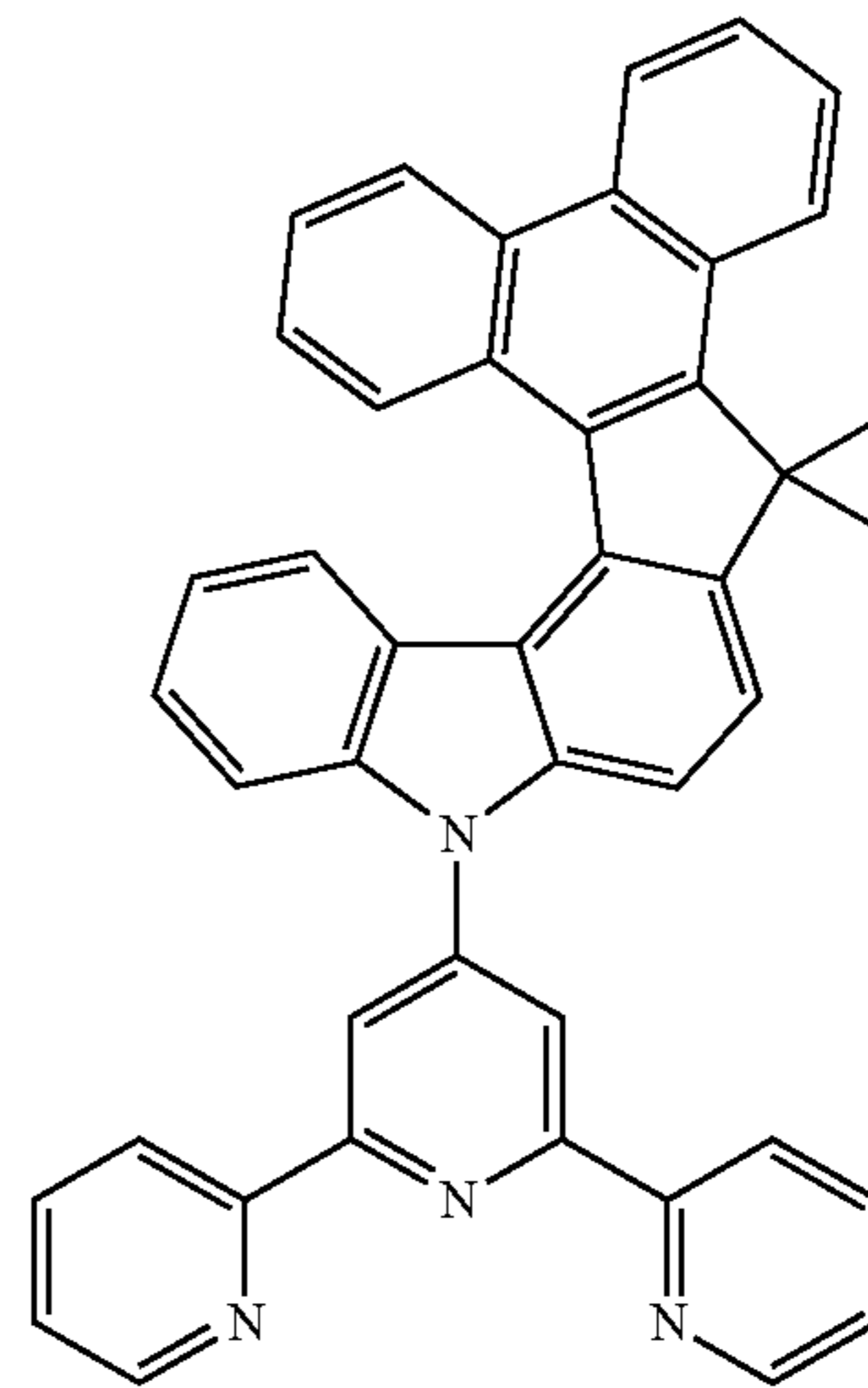
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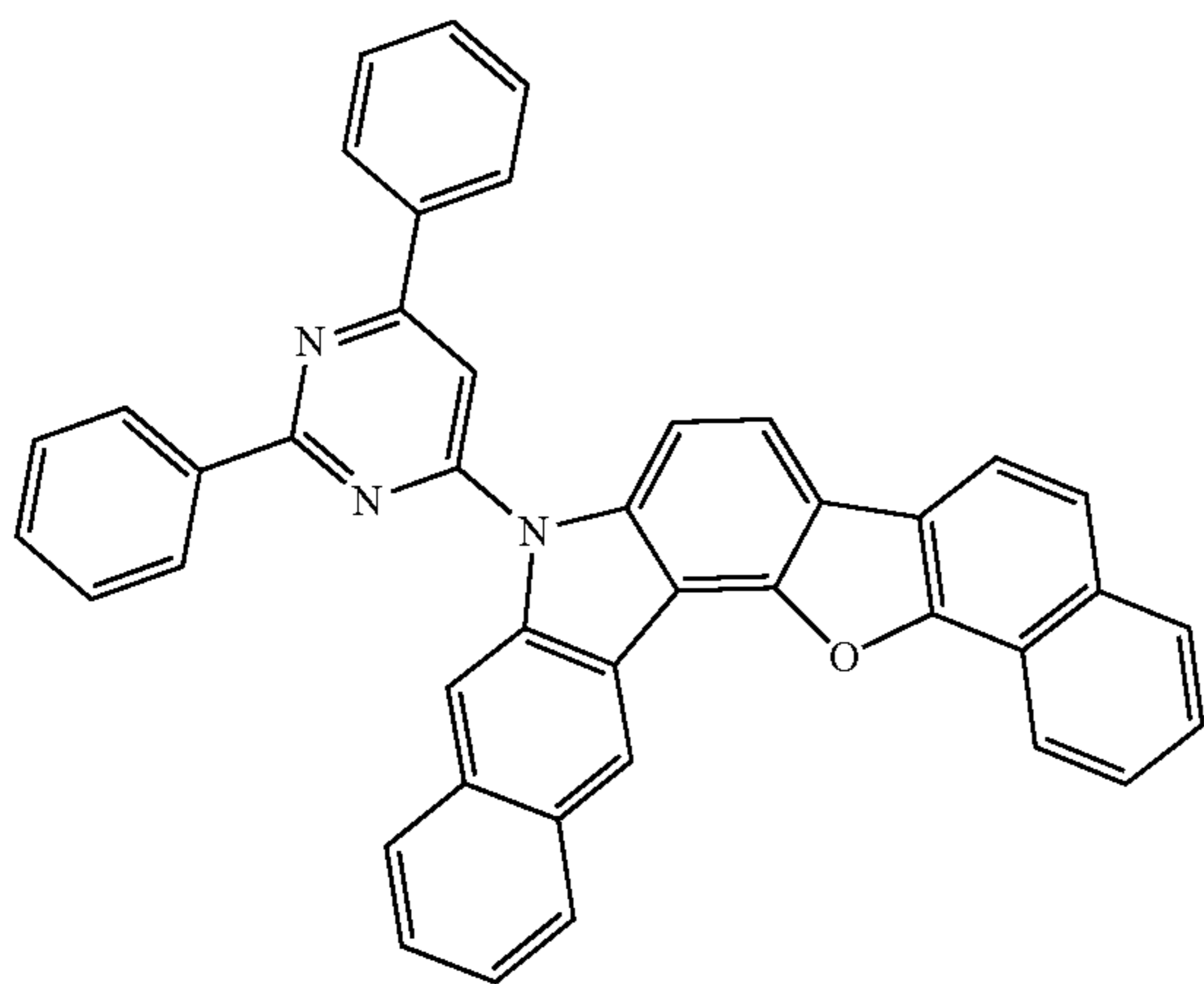
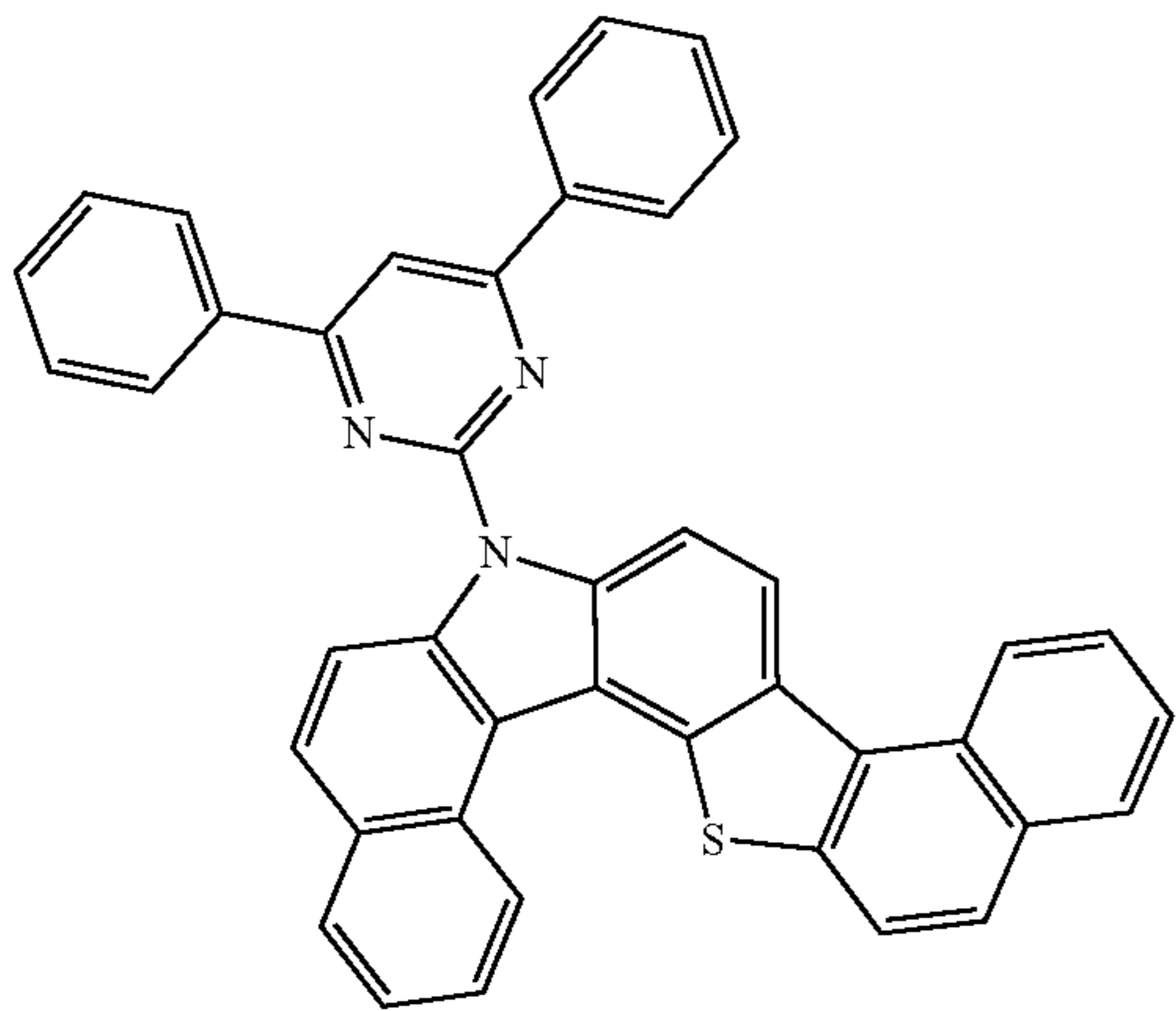
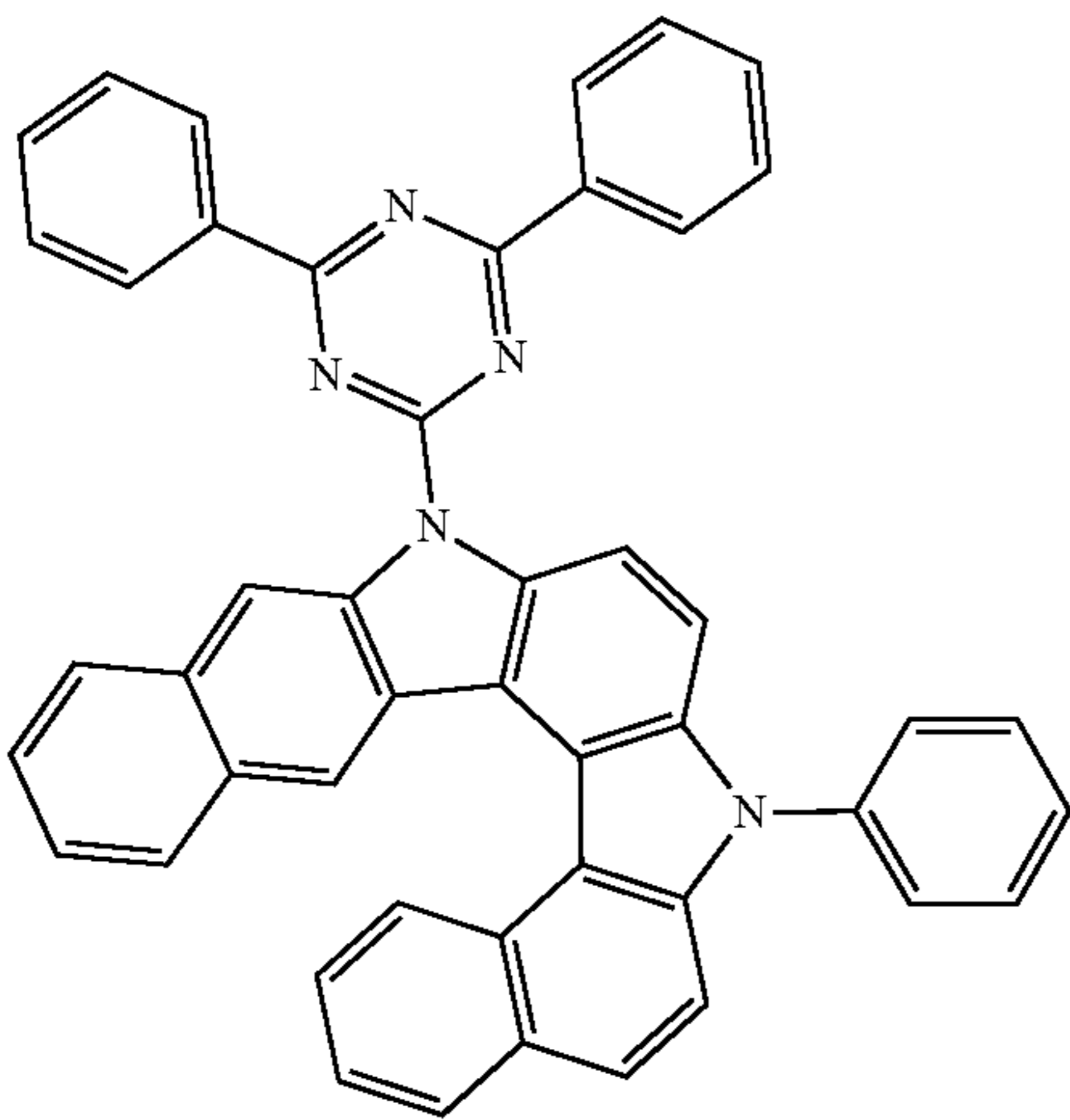
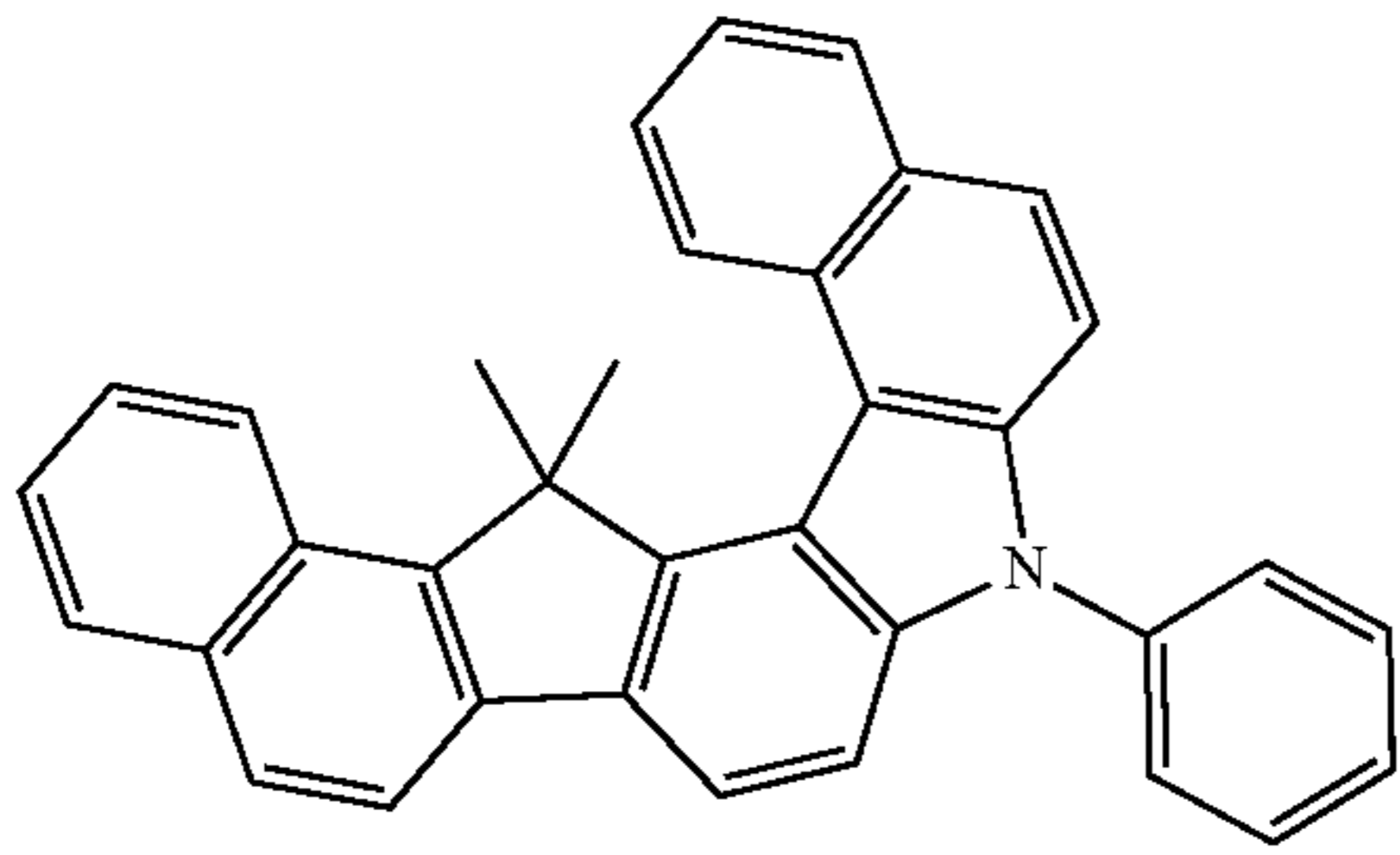
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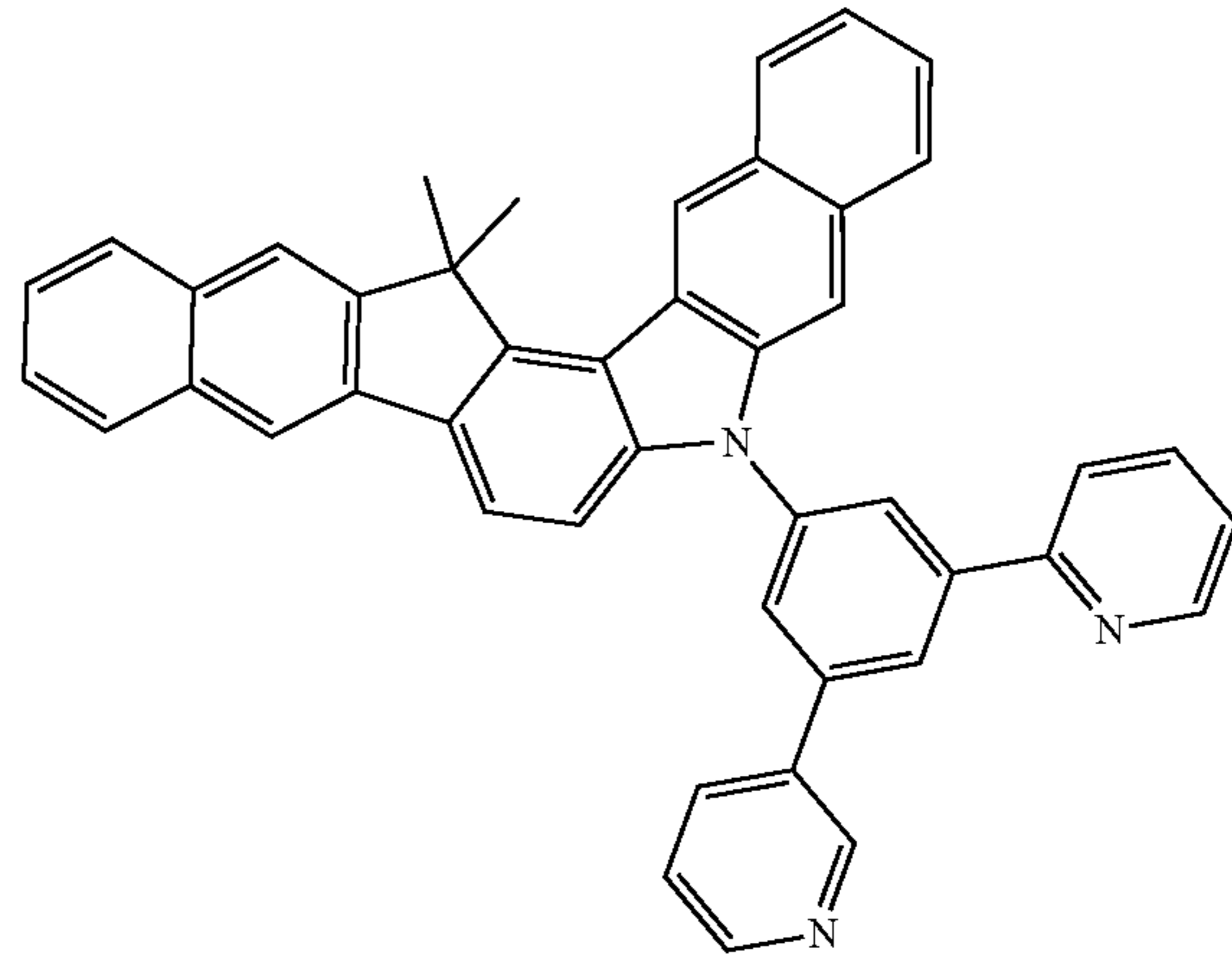
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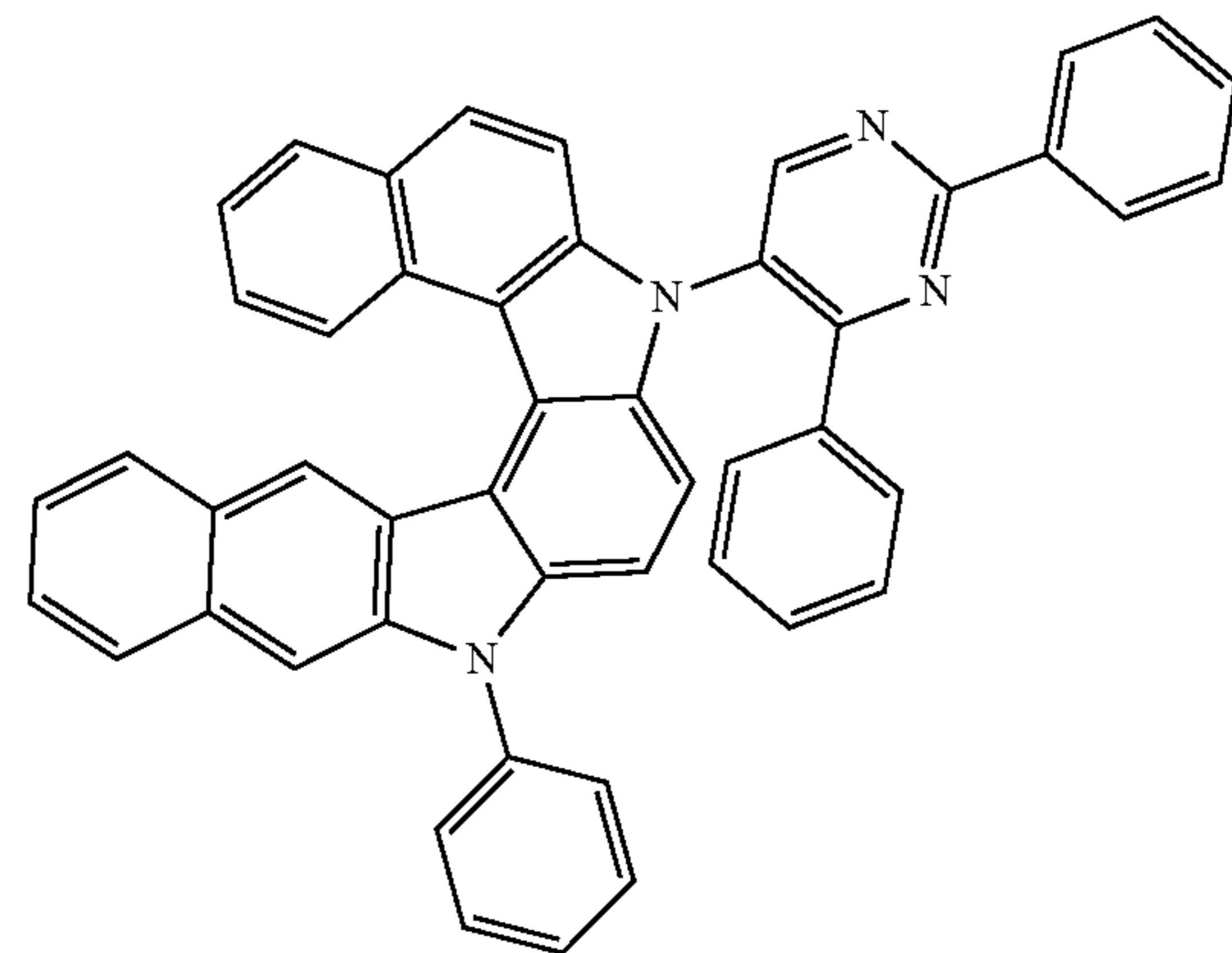
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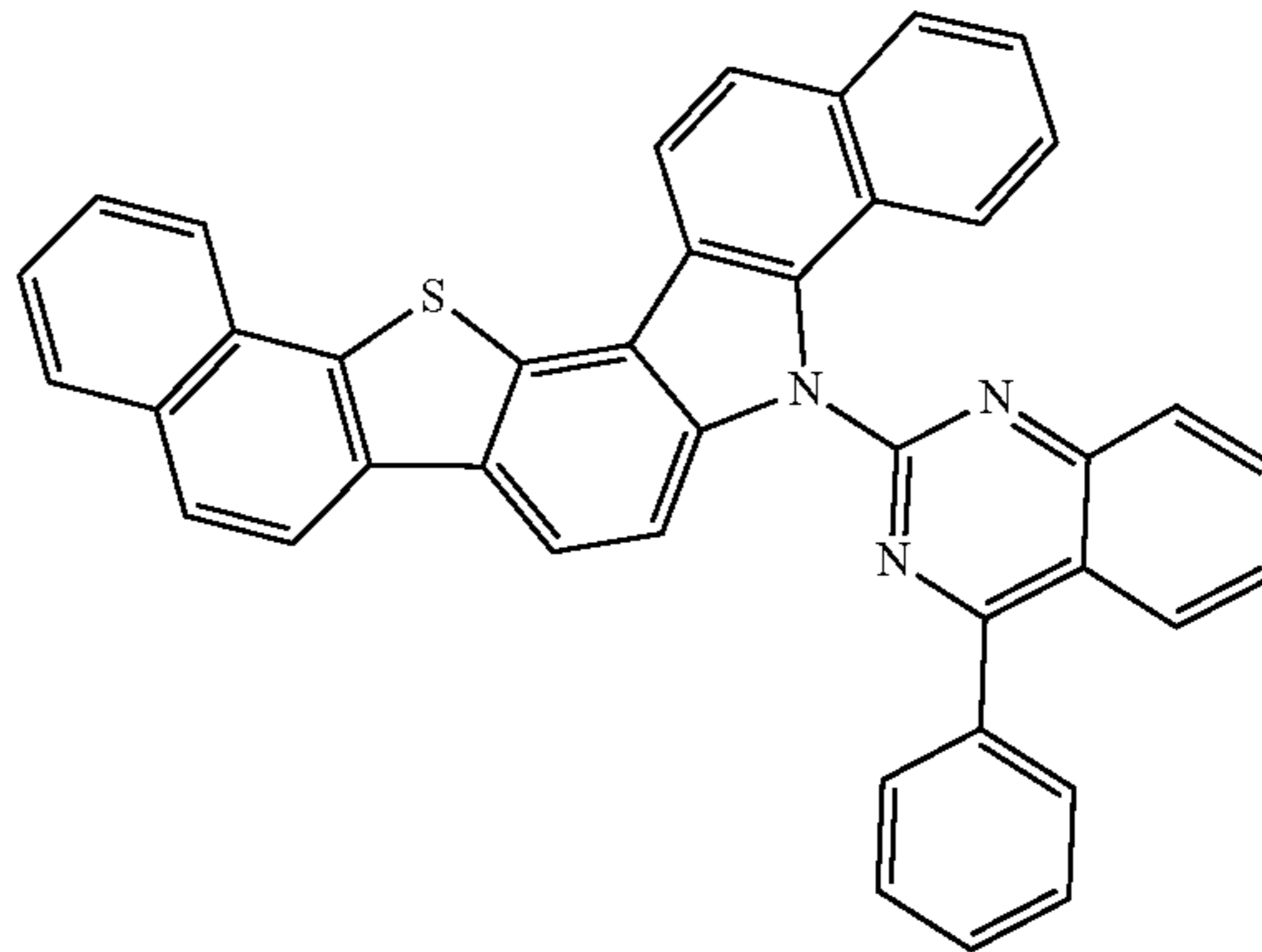
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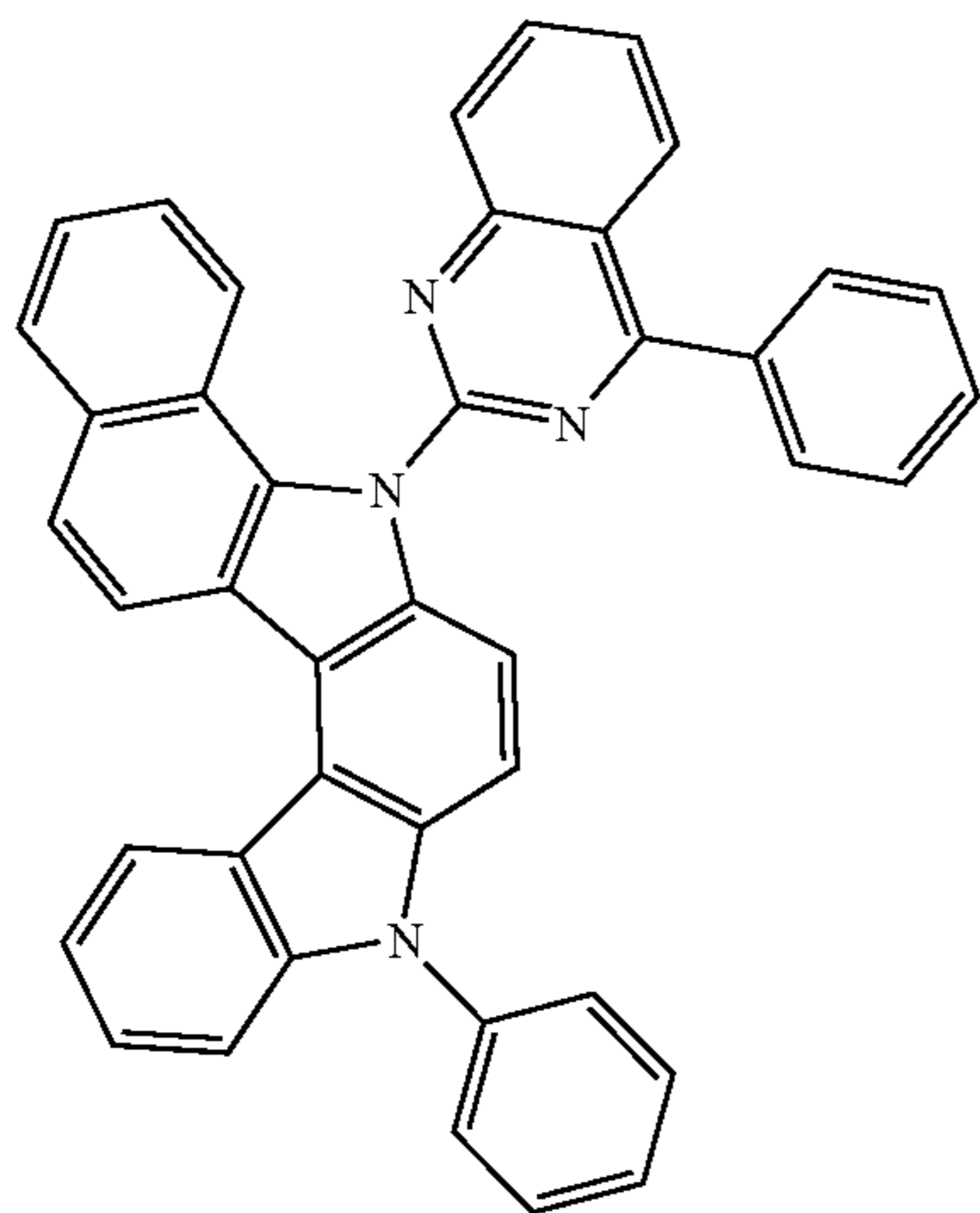
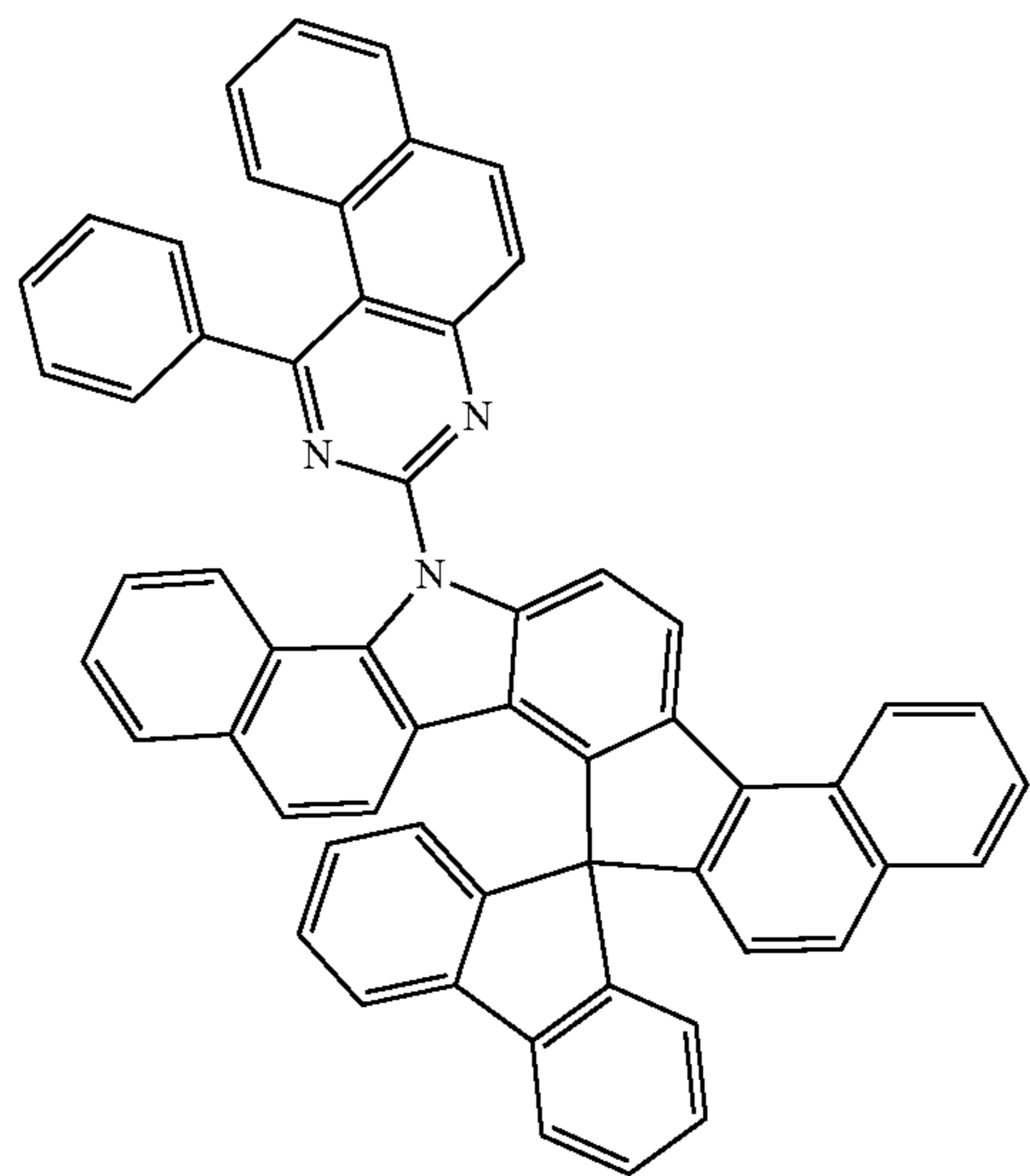
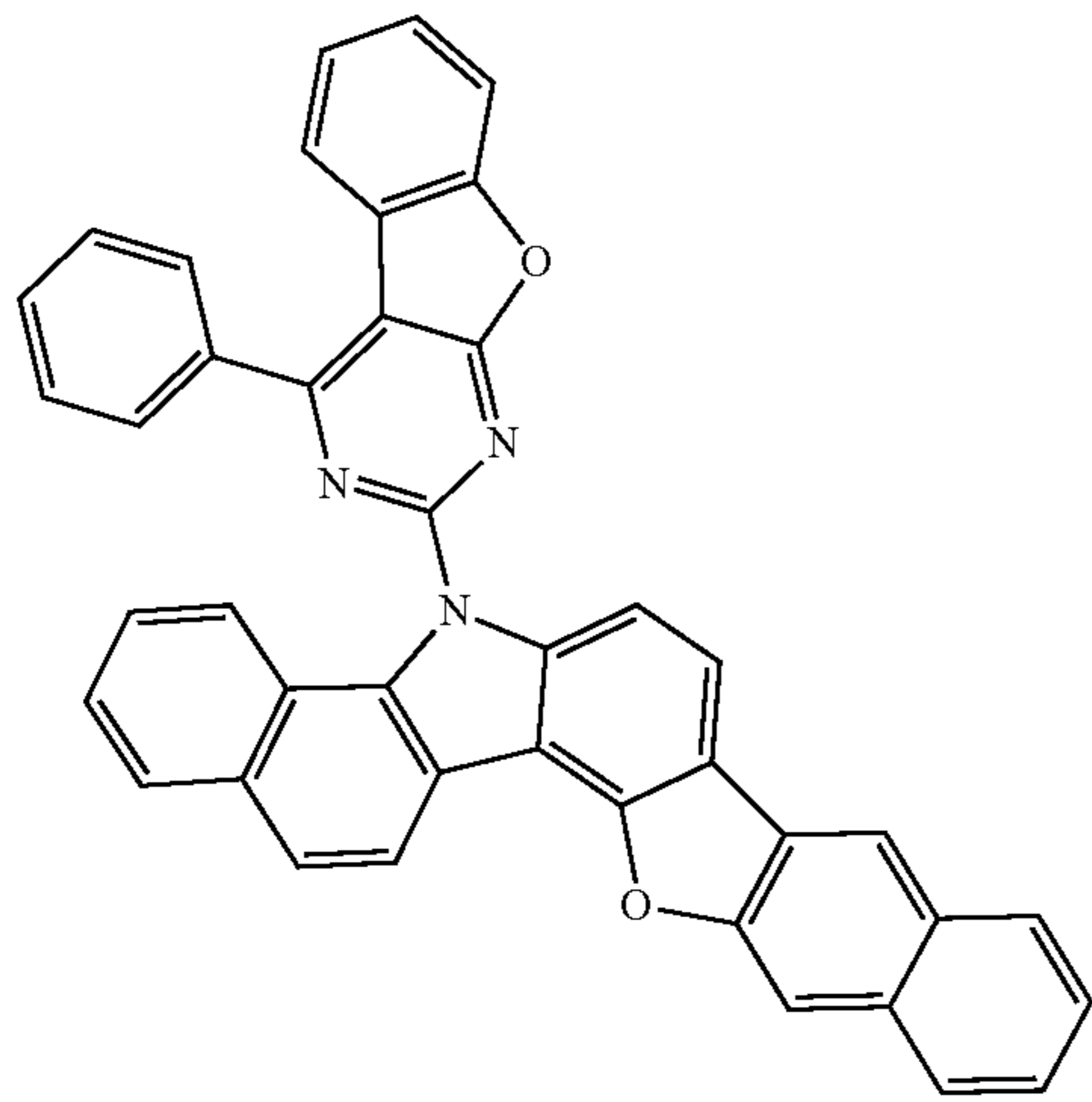


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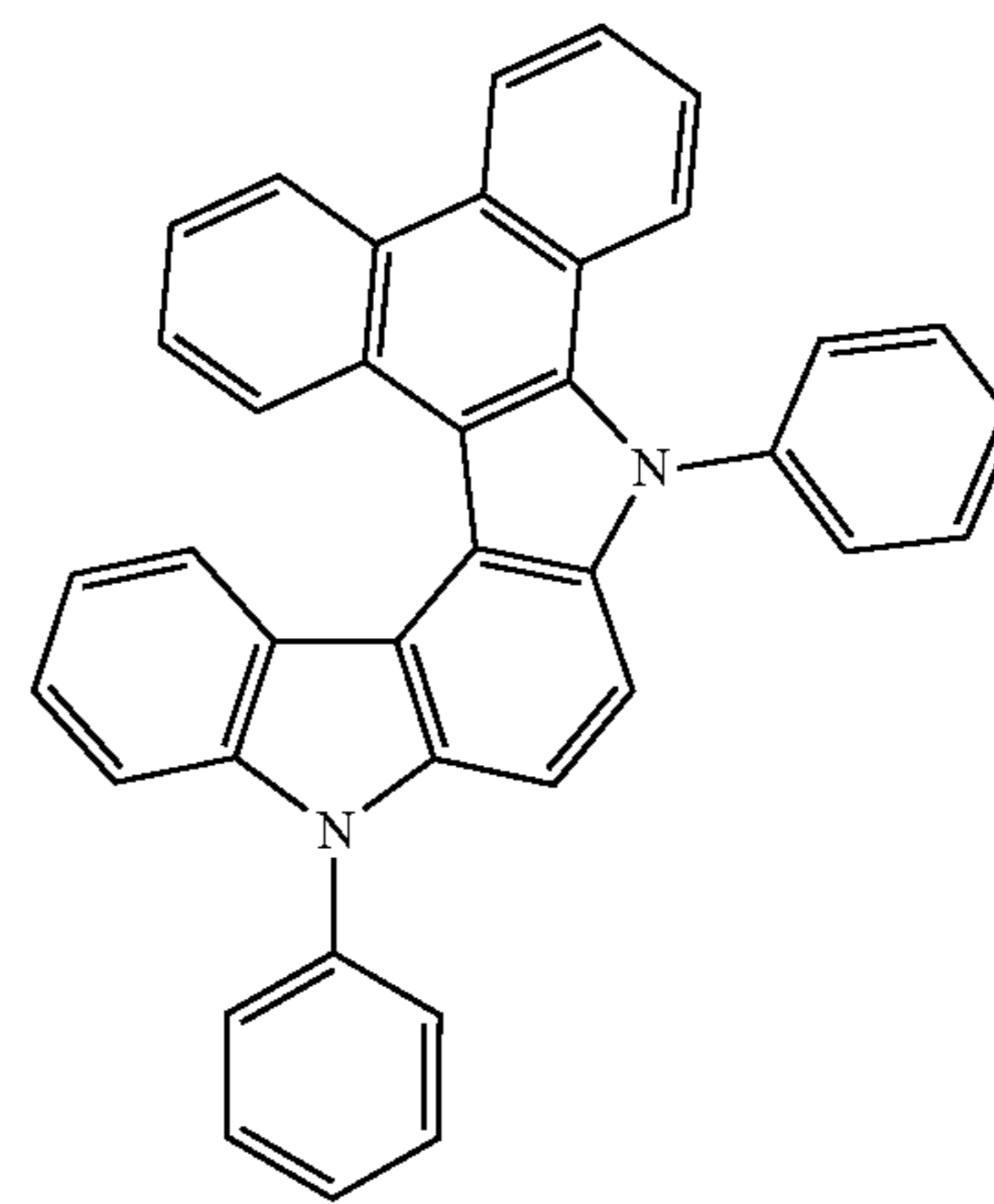
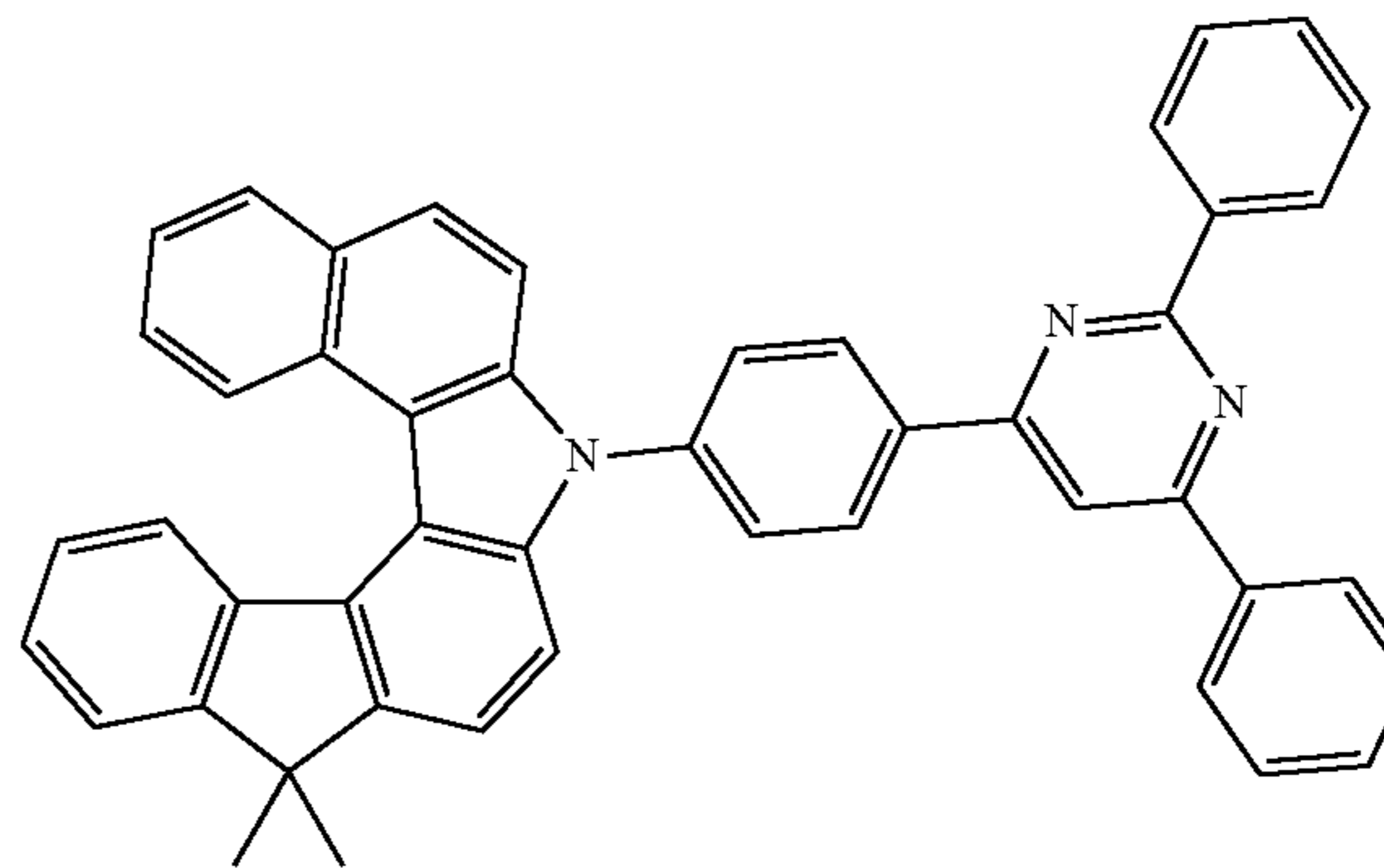
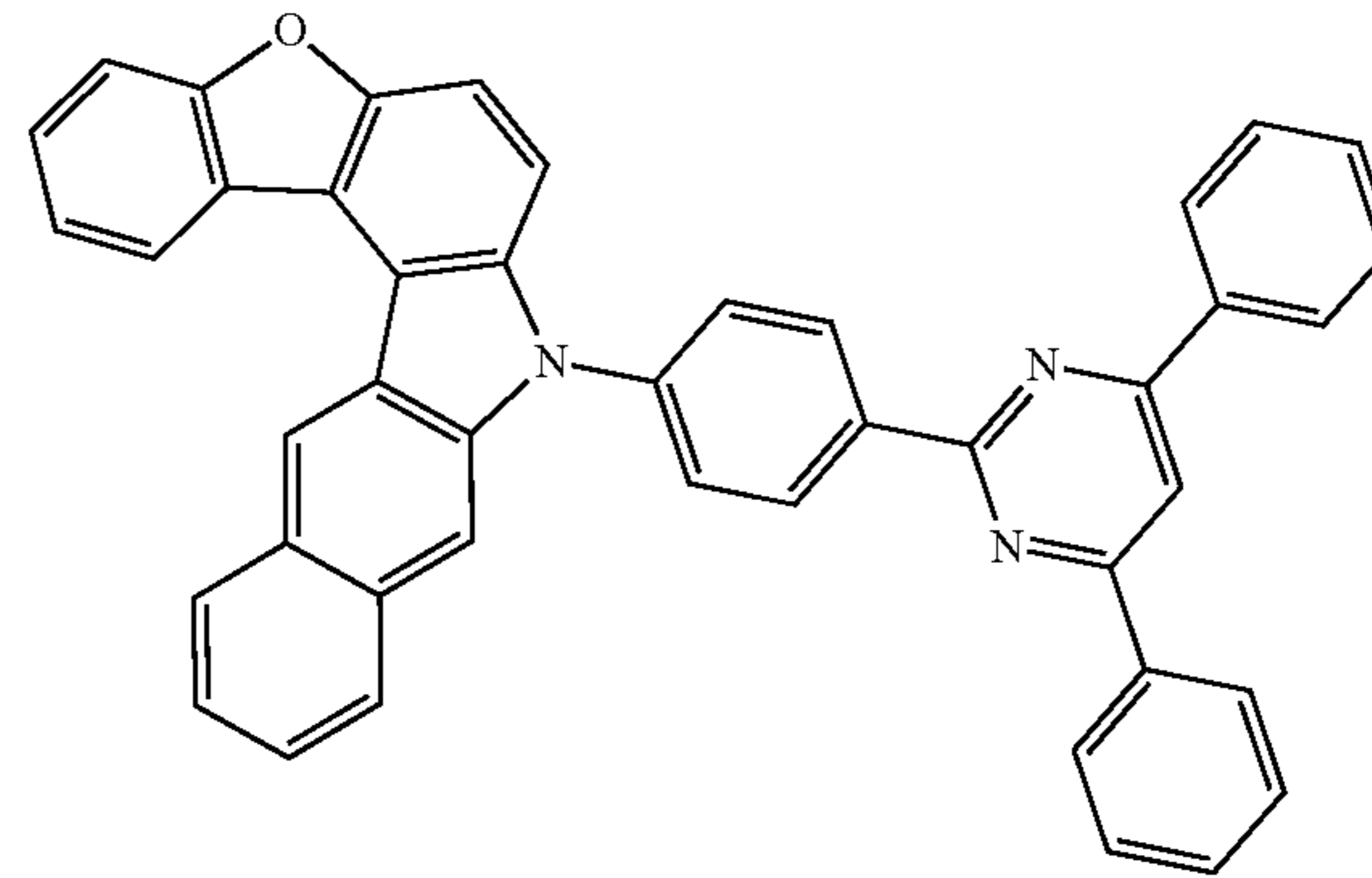
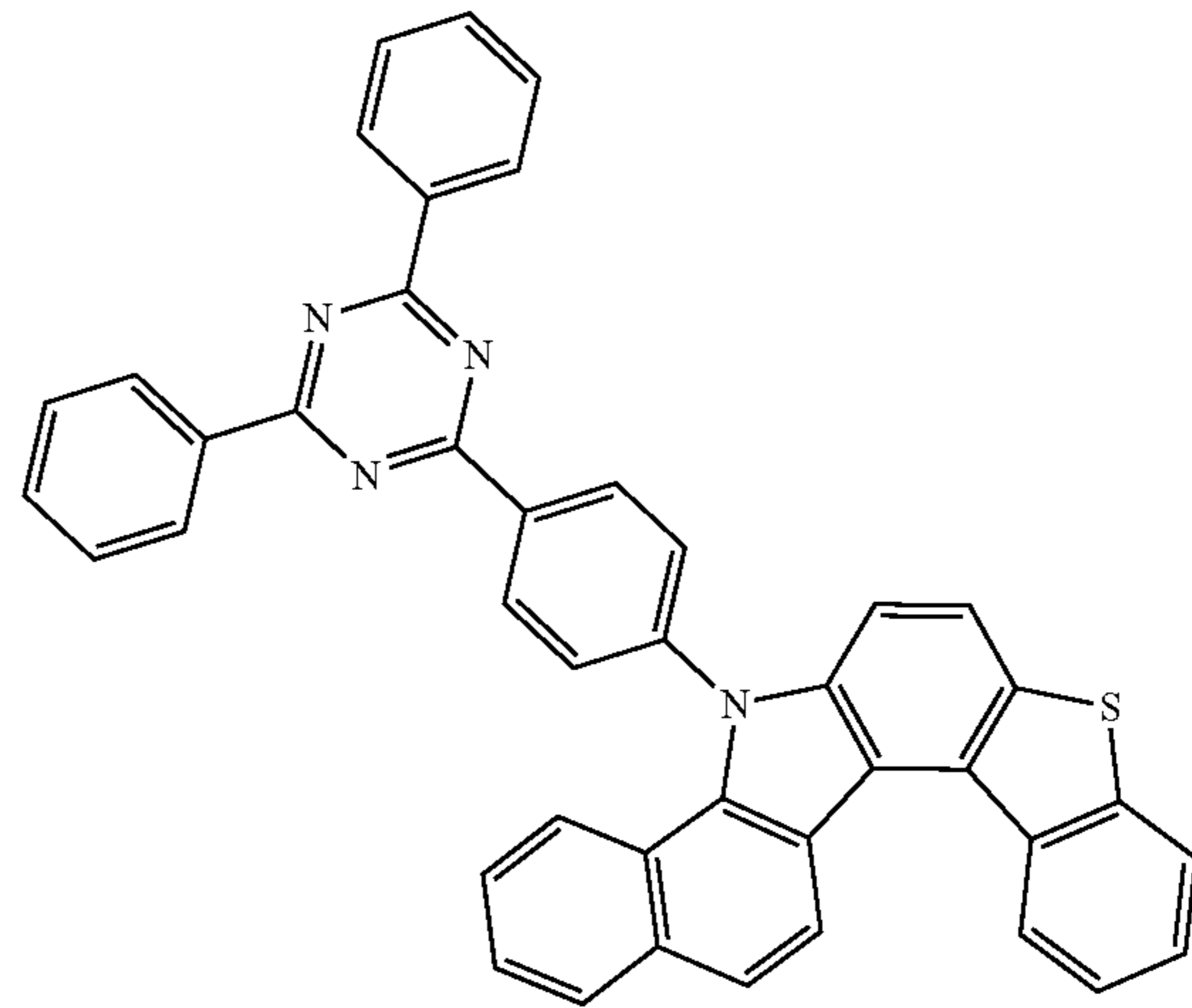
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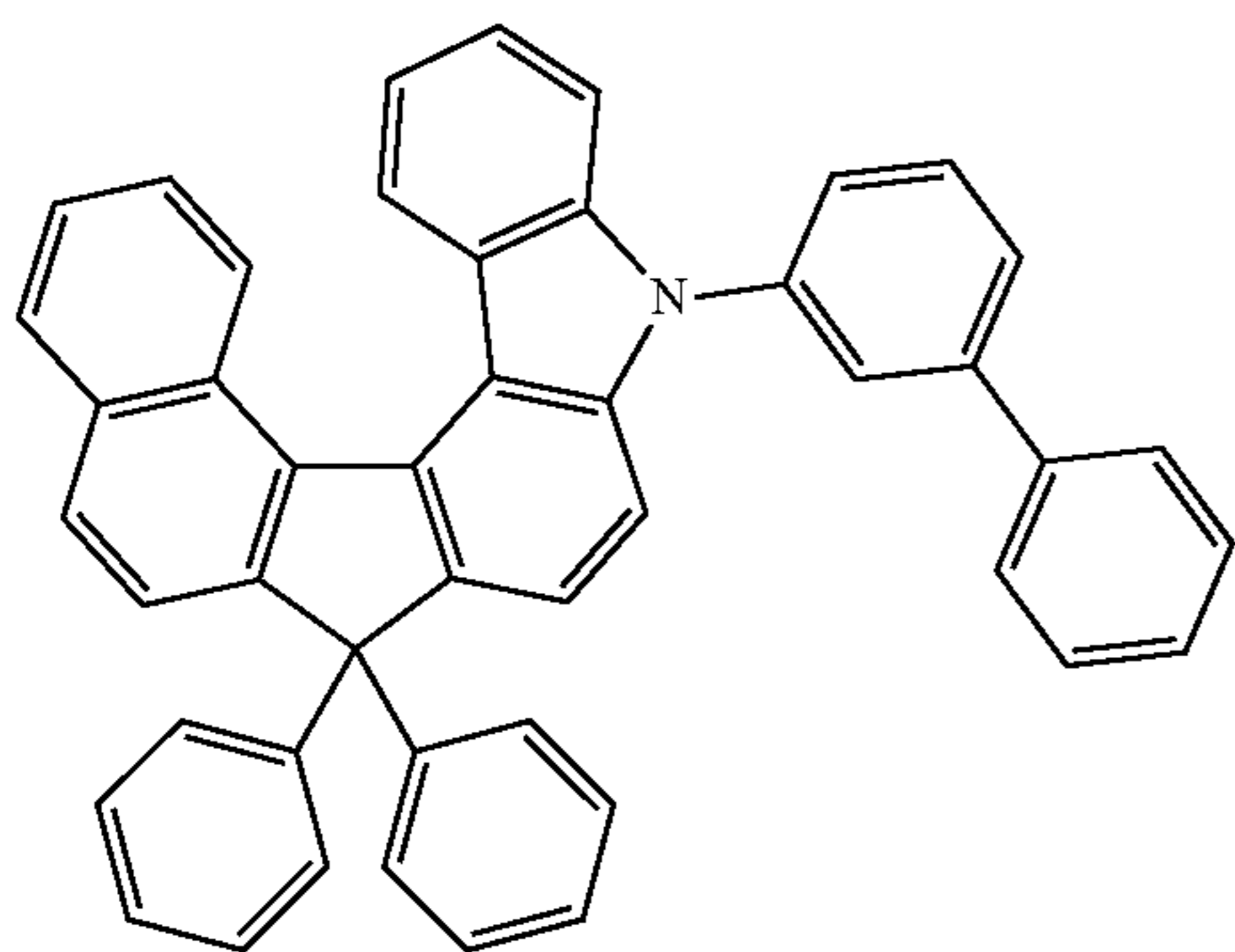
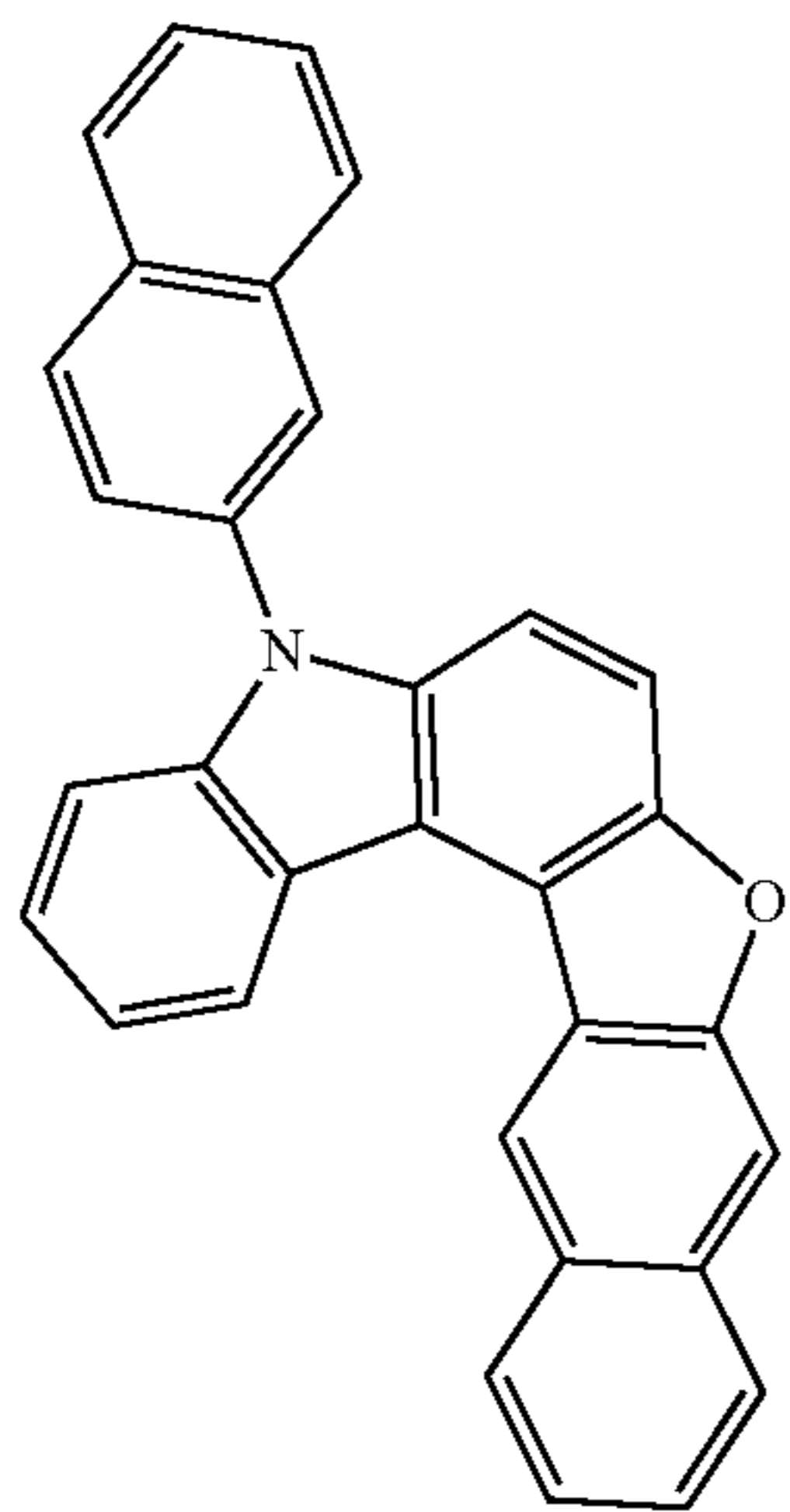
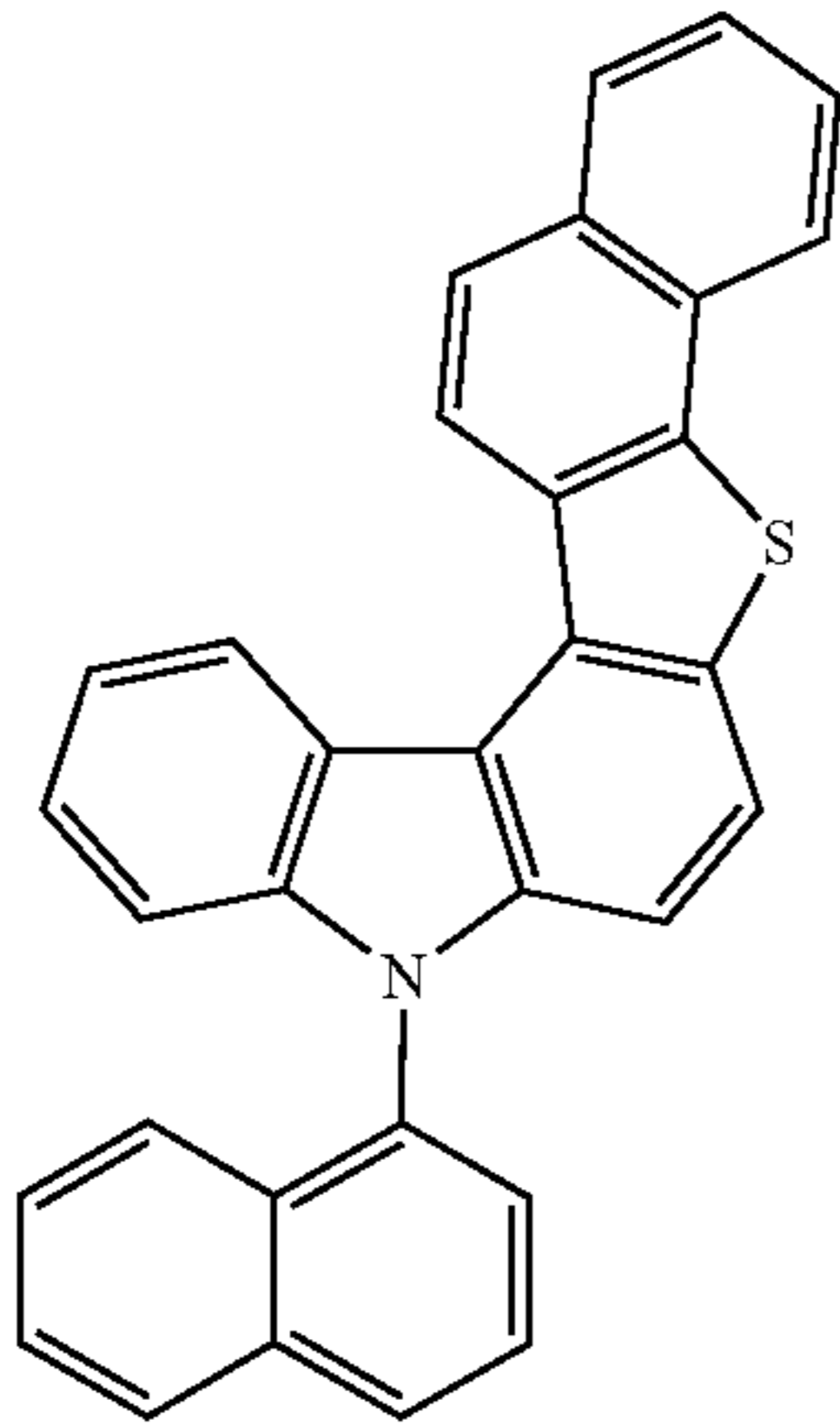
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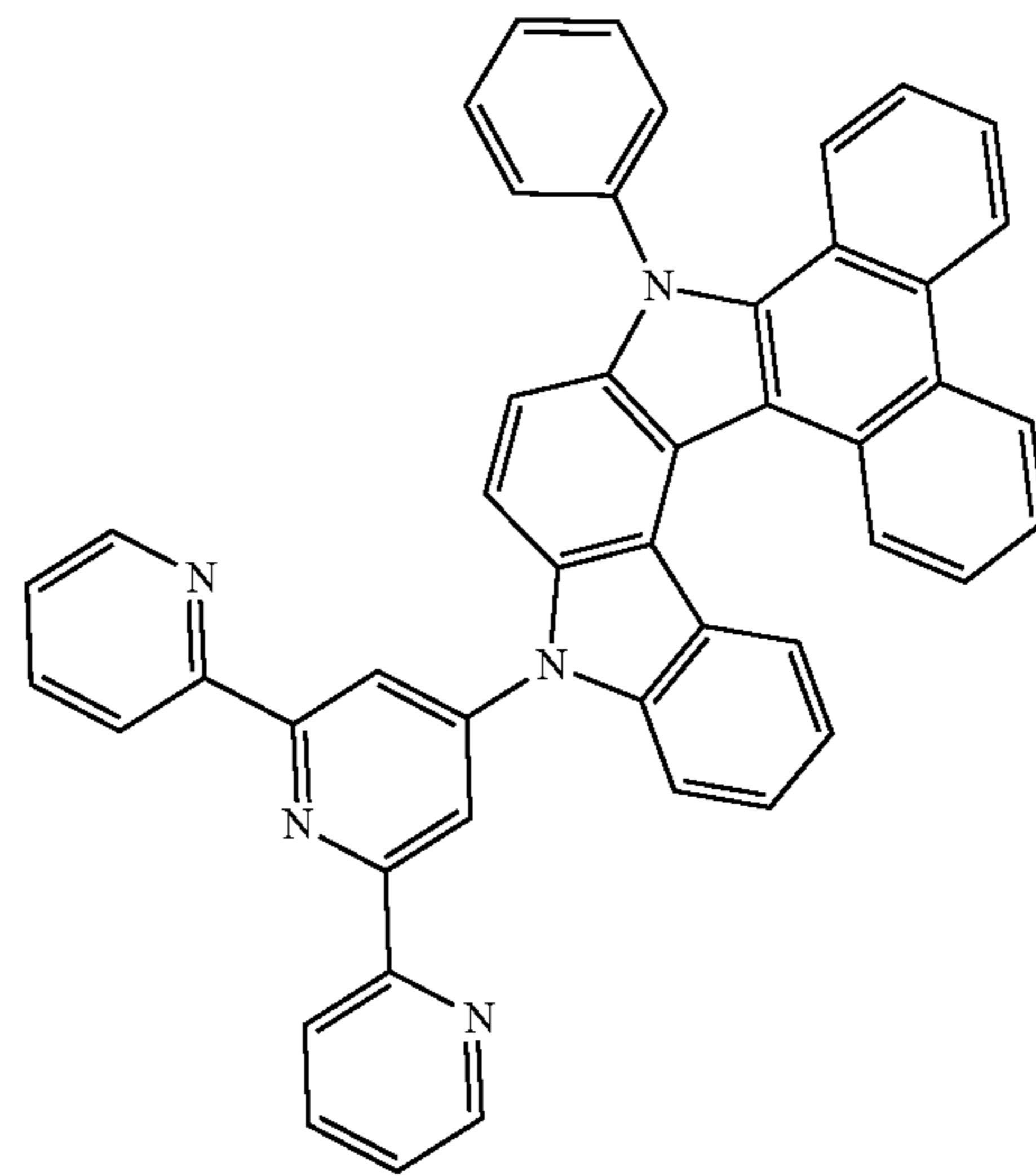
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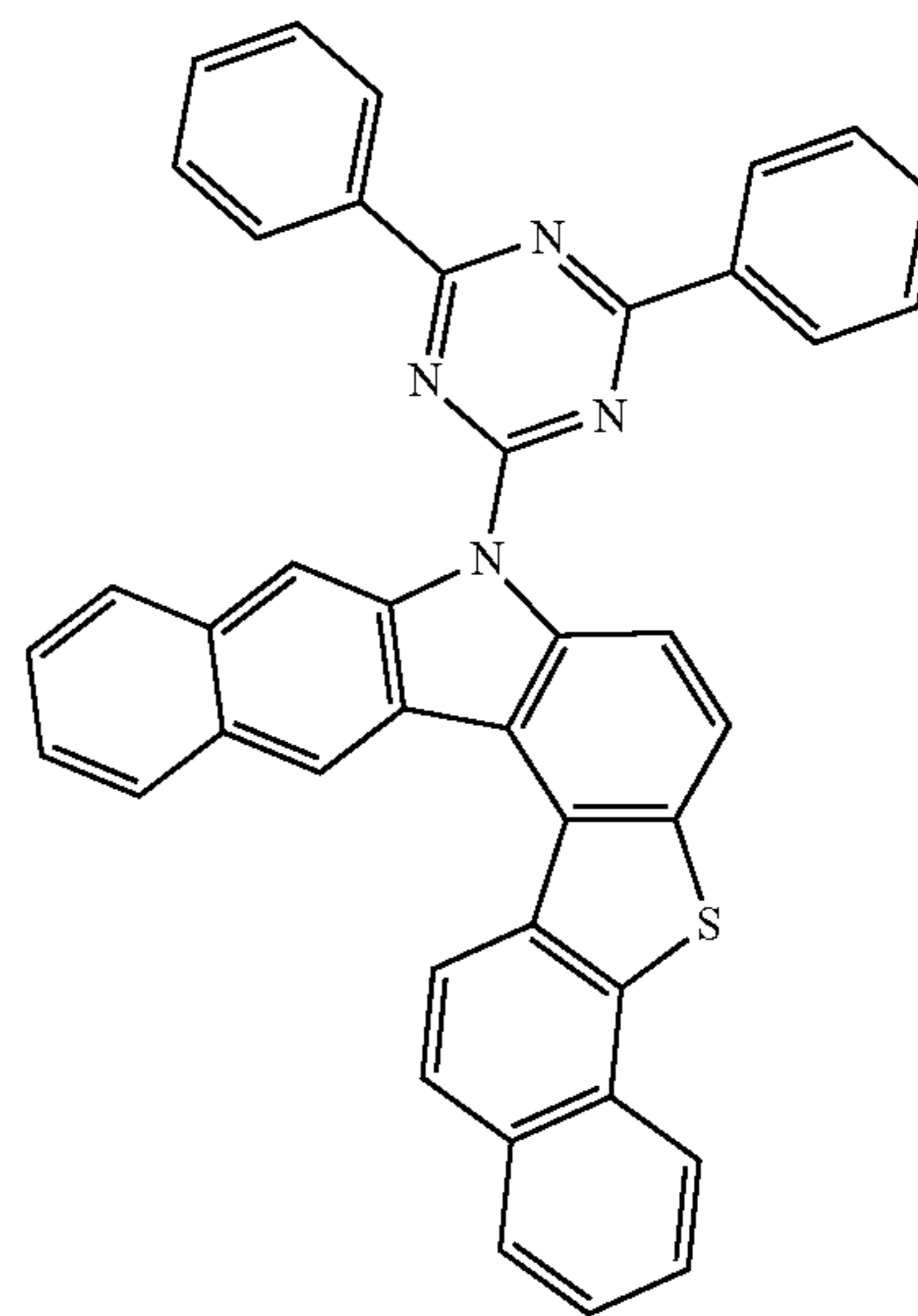
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3-58

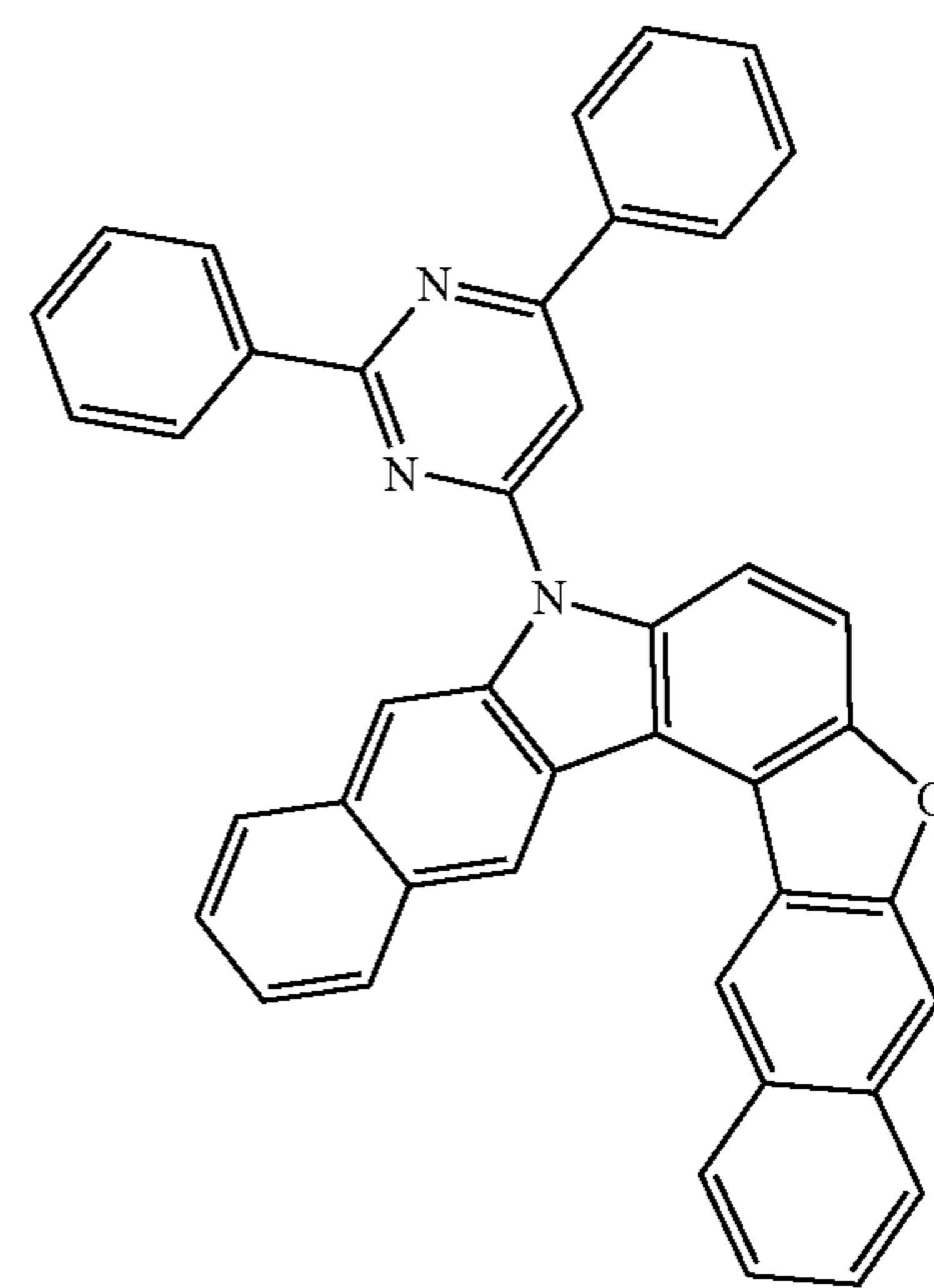
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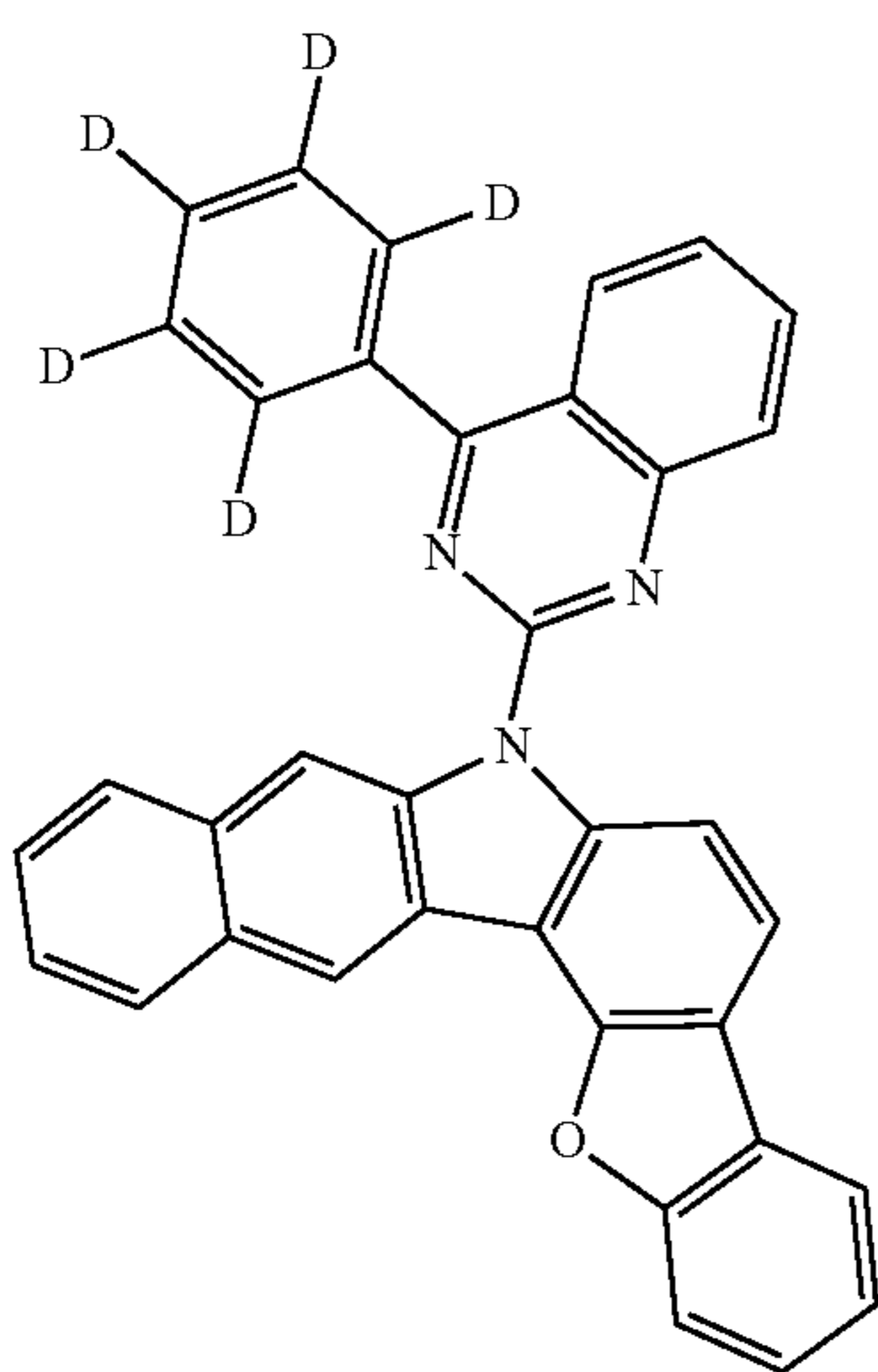
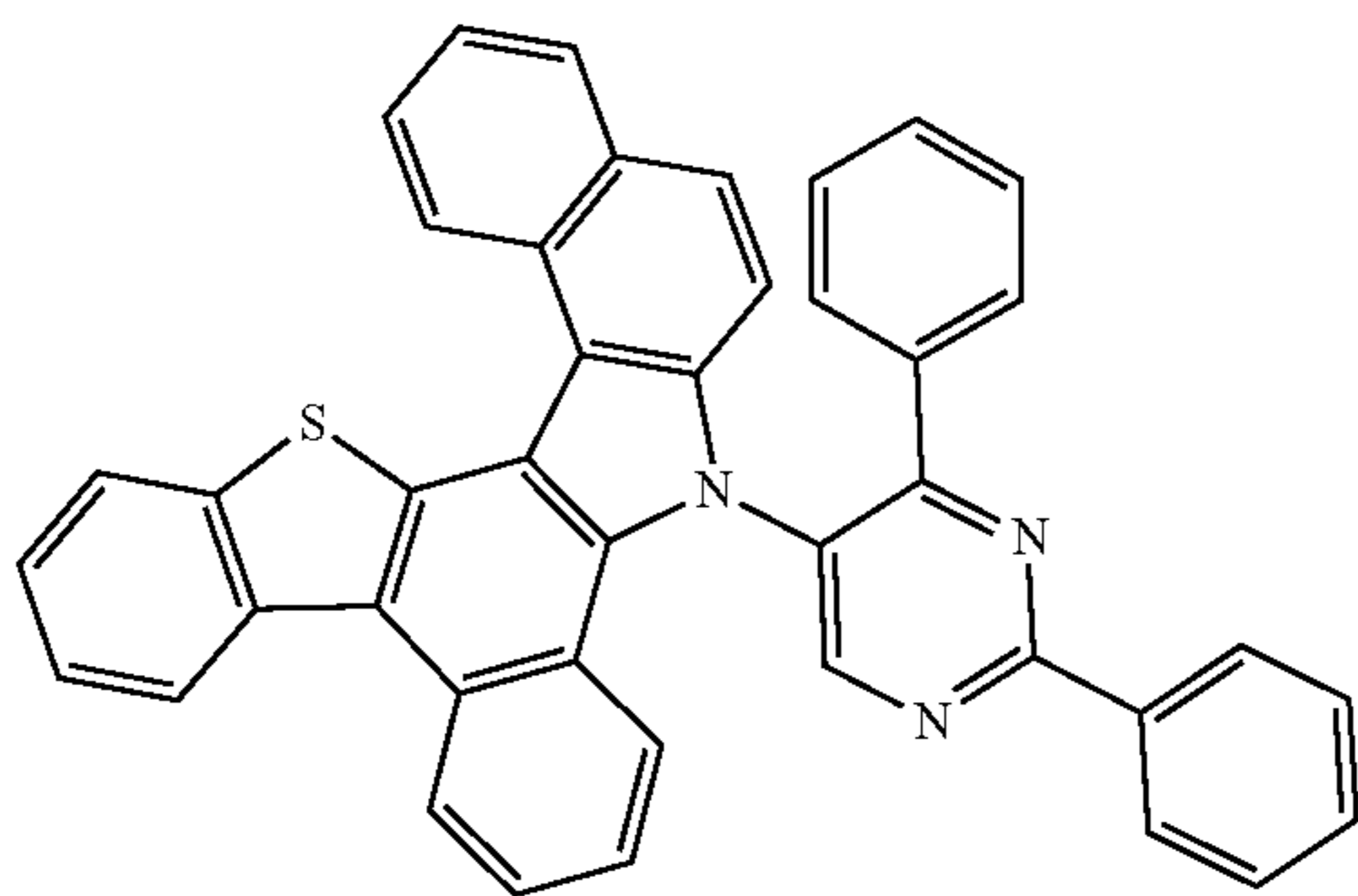
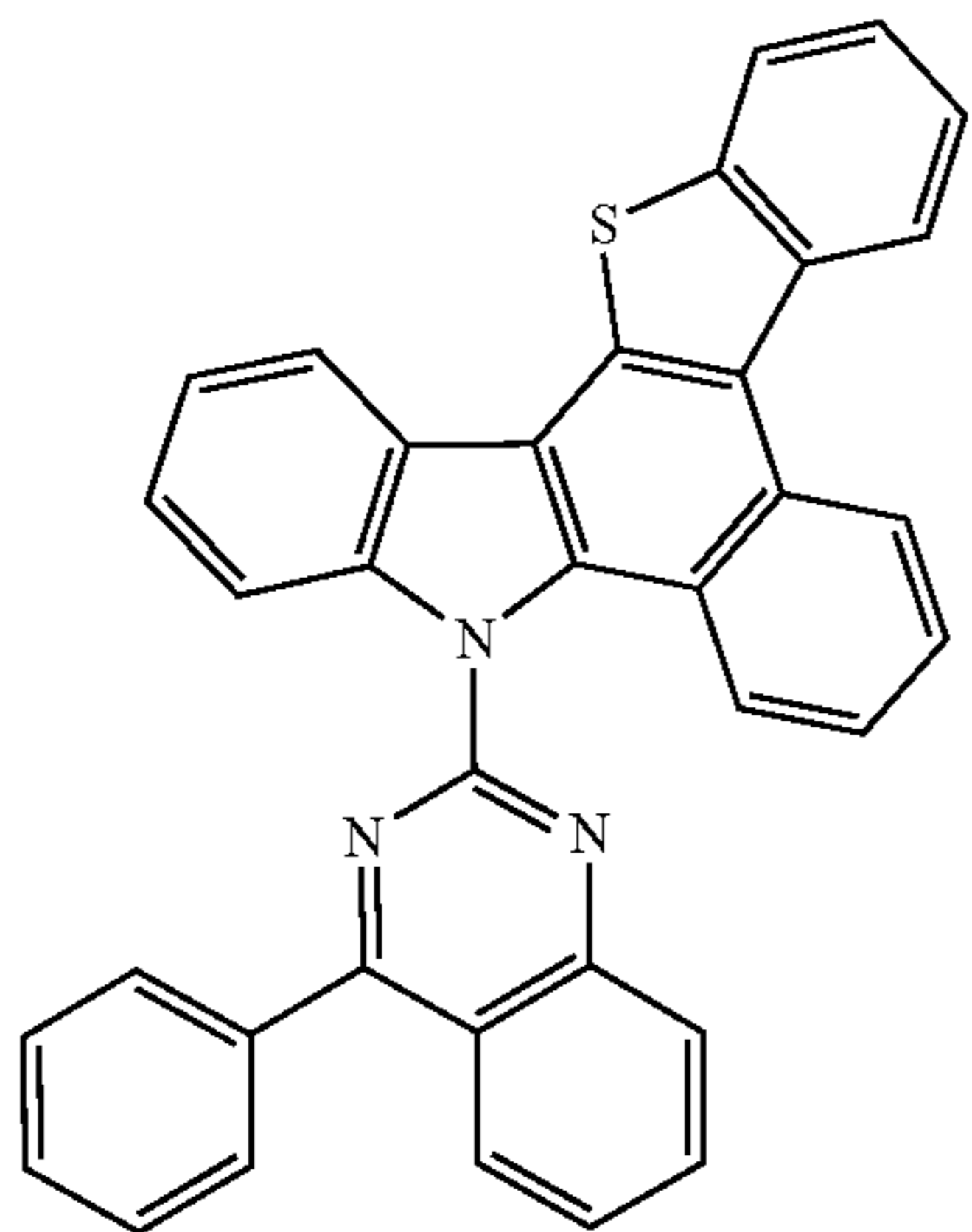
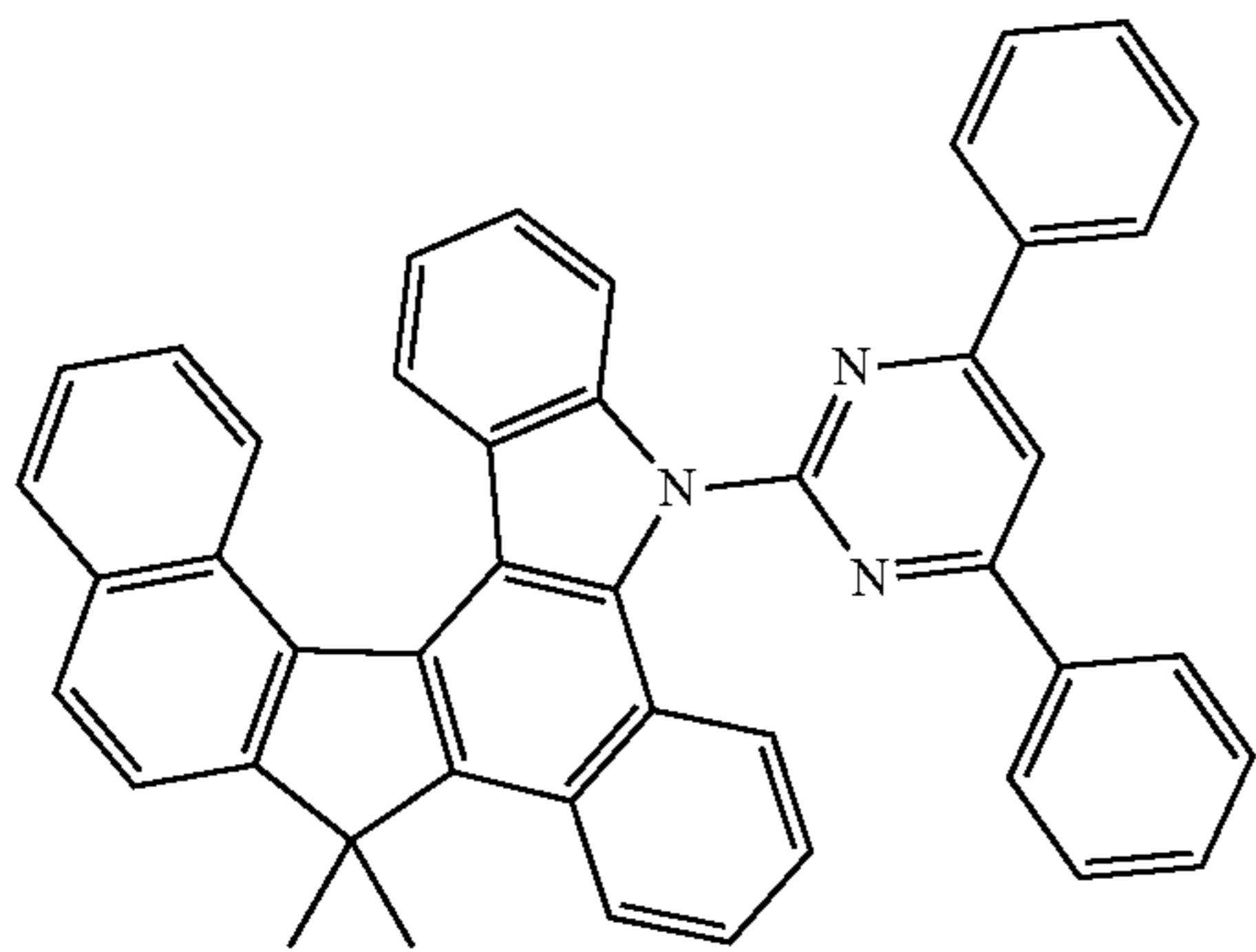
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3-59

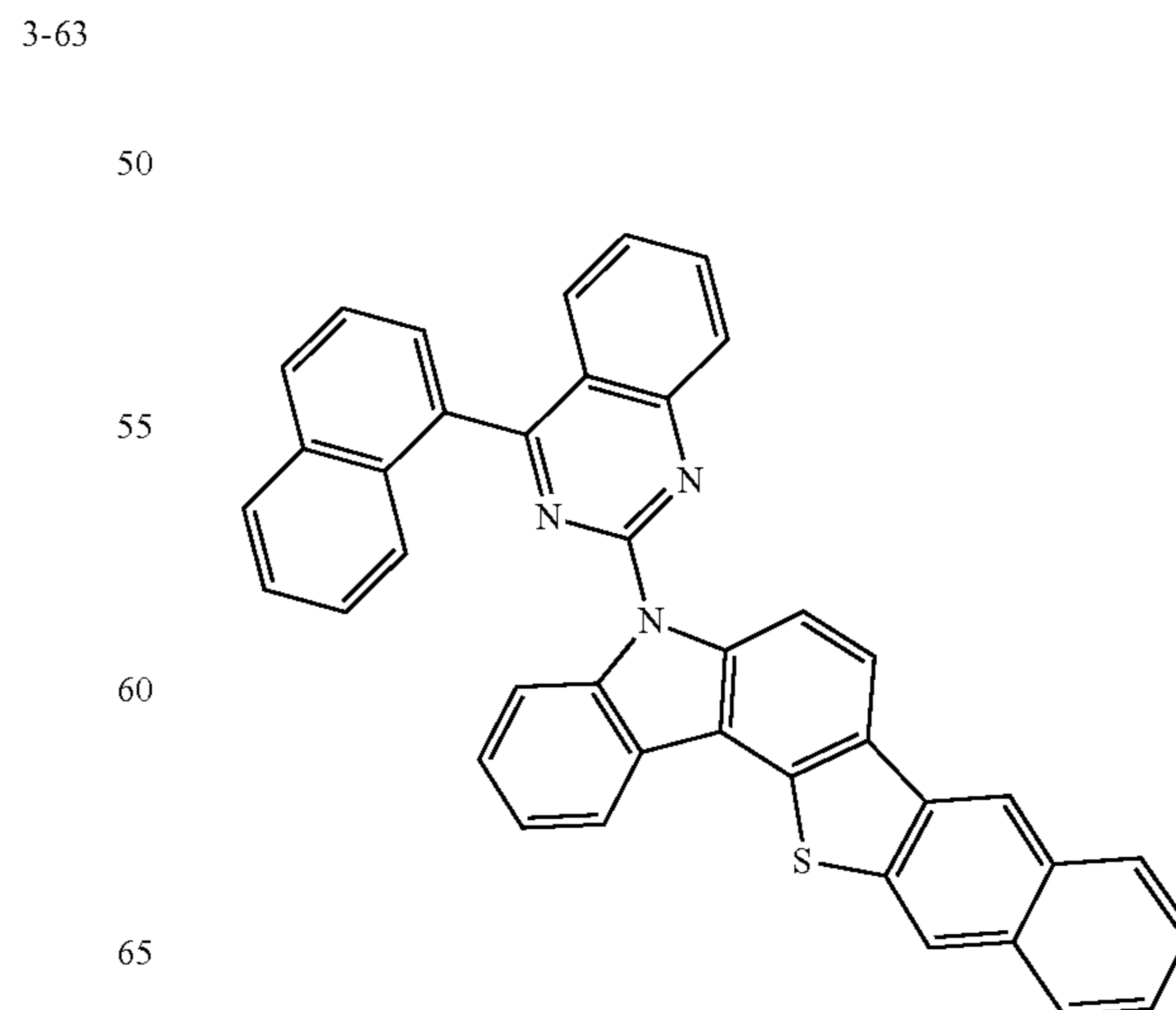
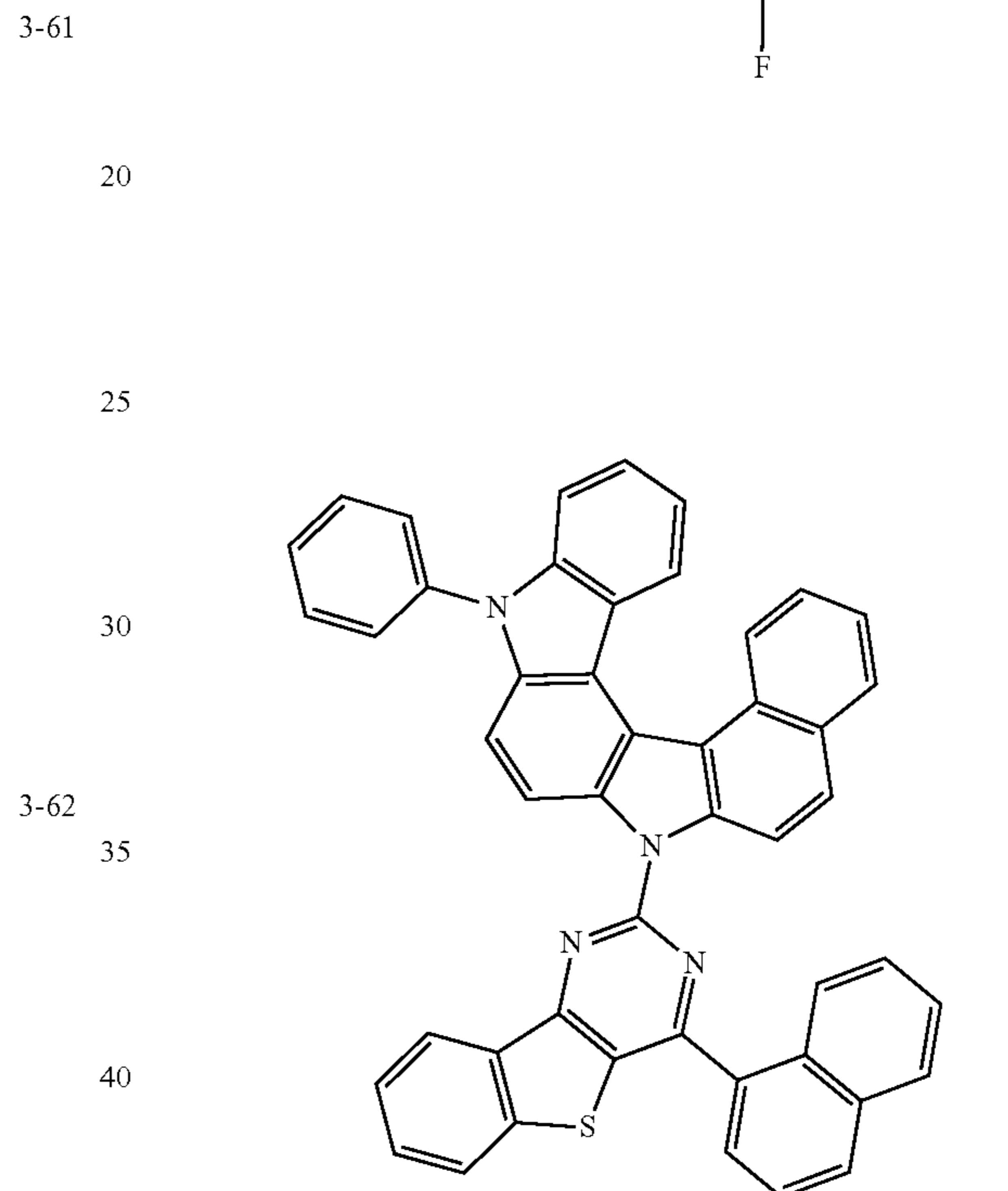
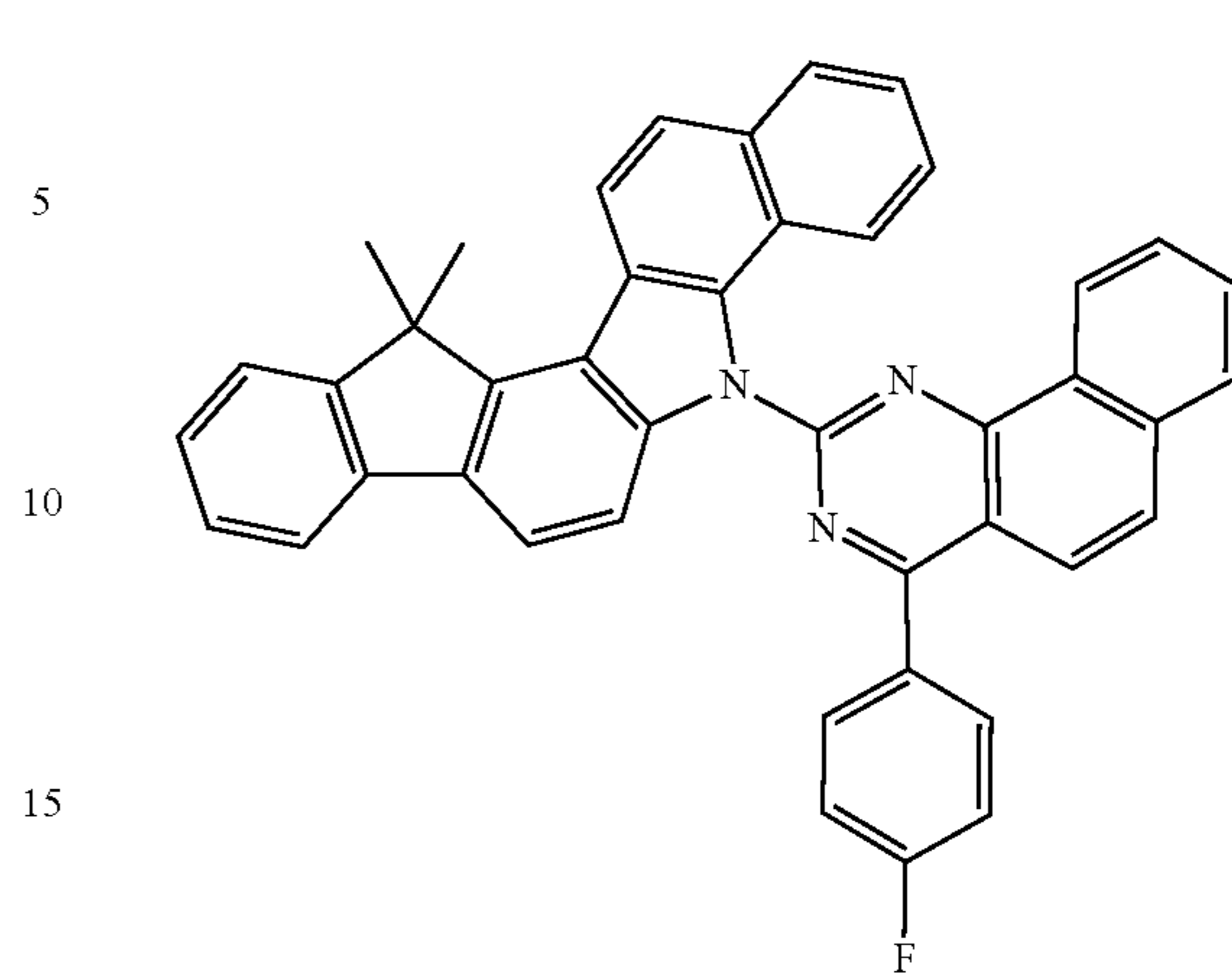
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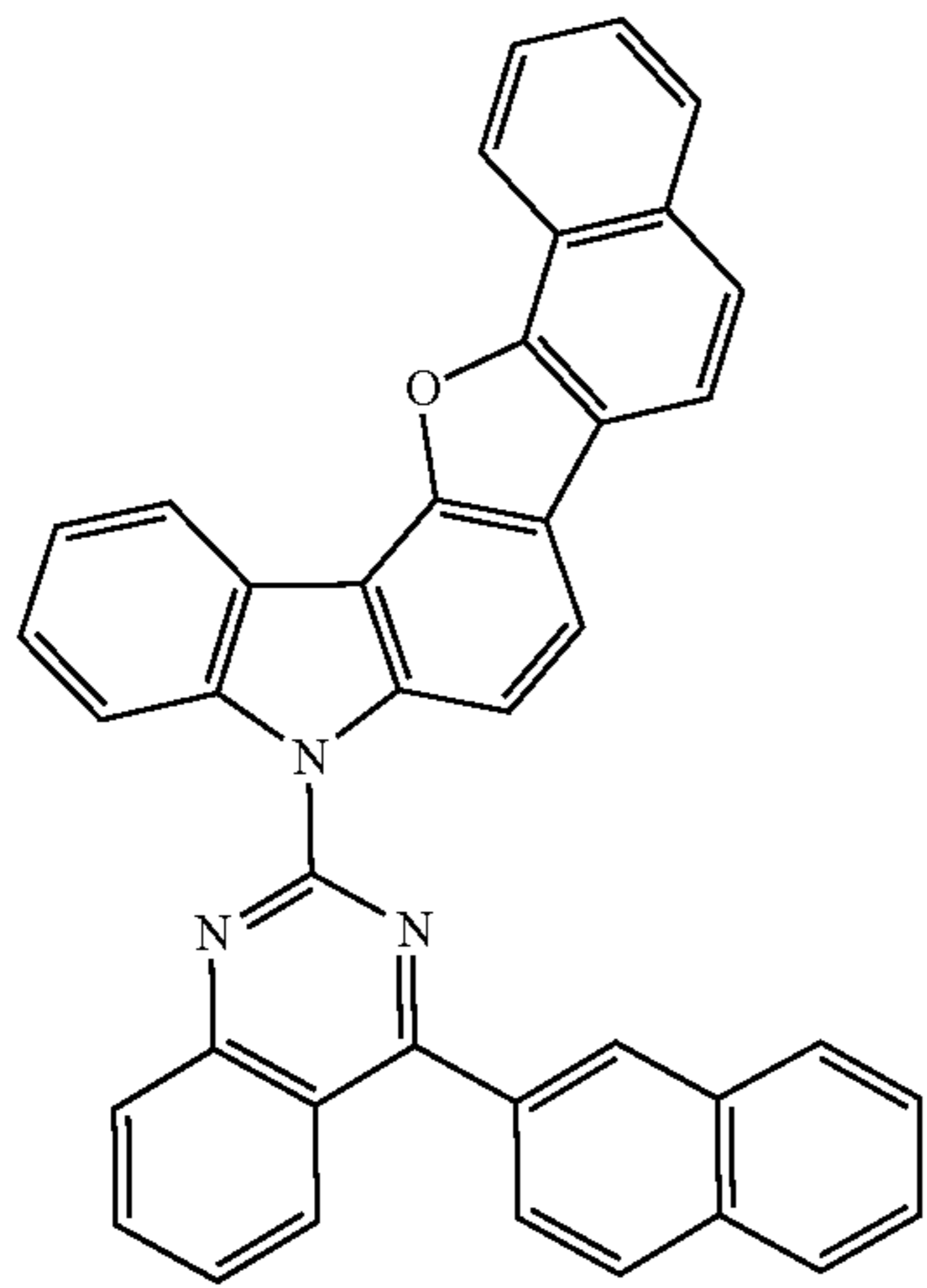
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71

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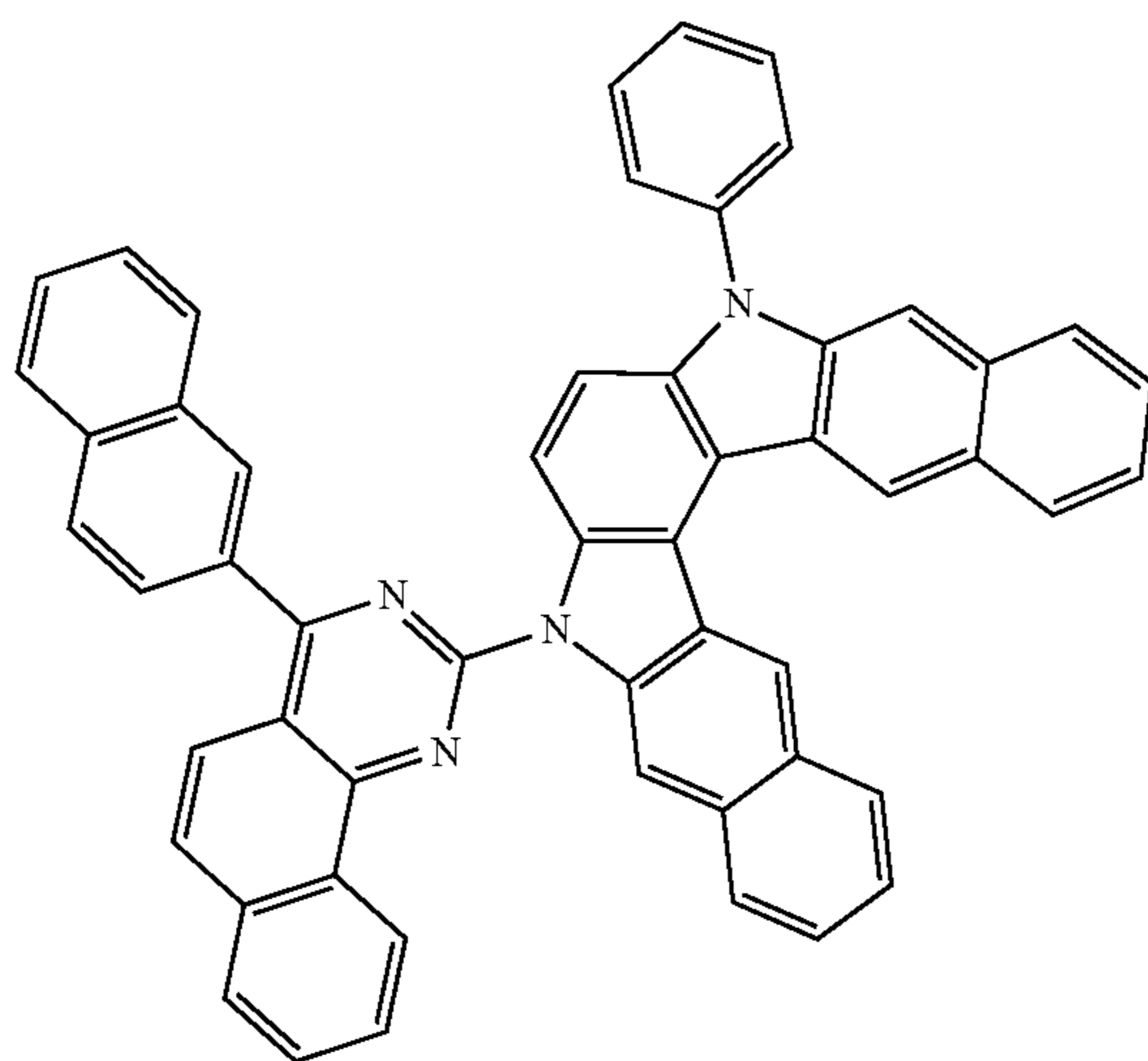
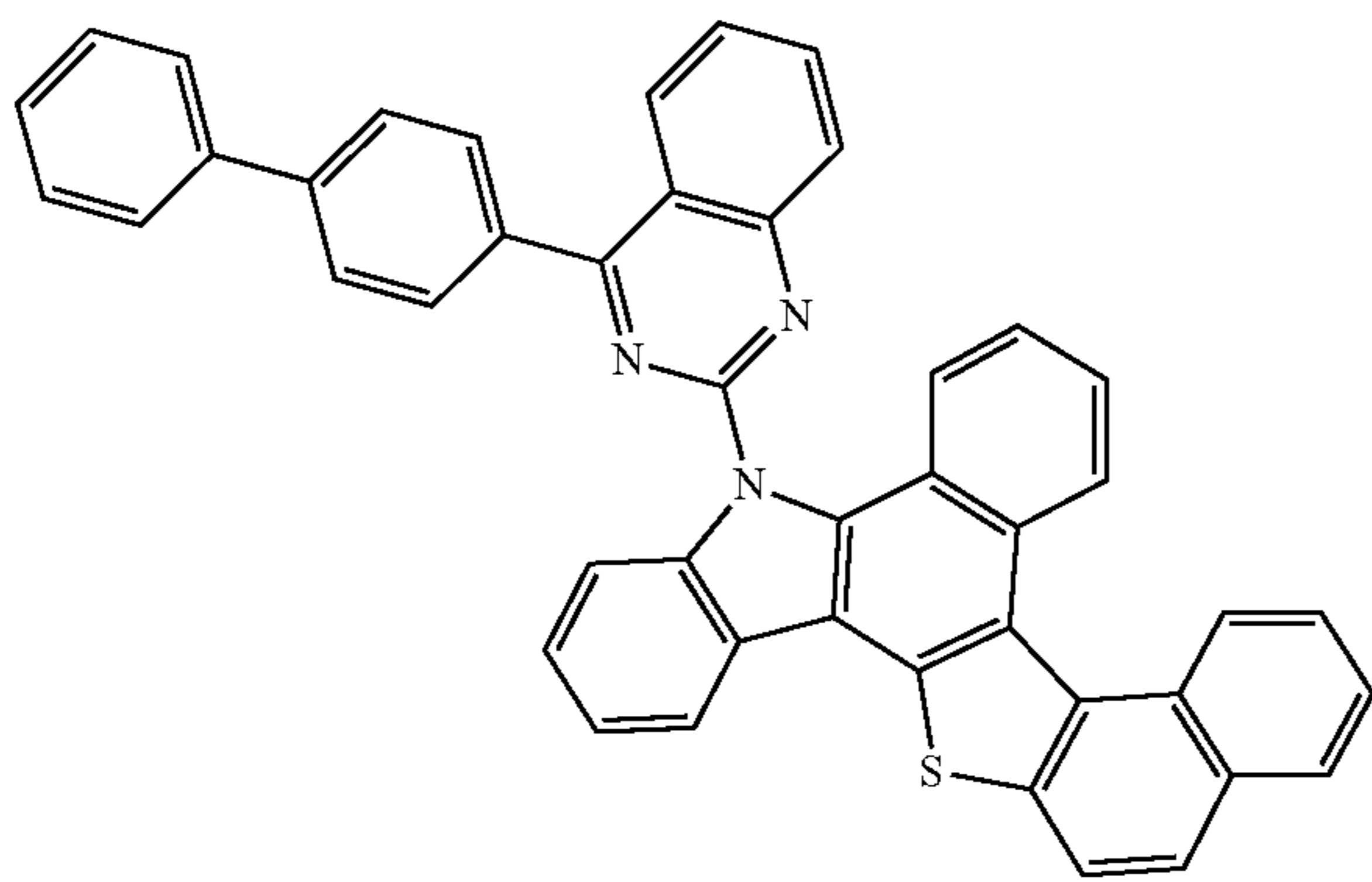
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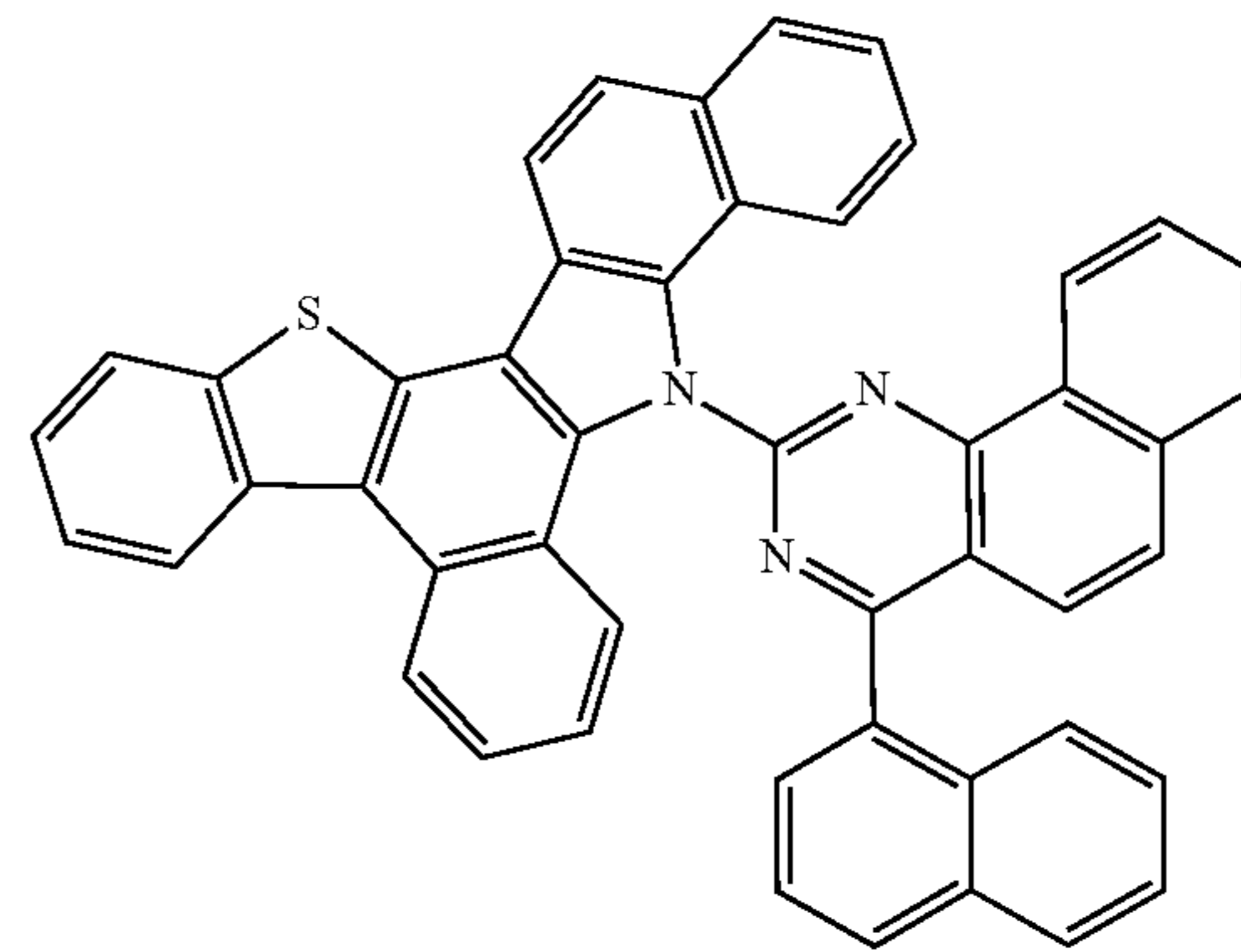
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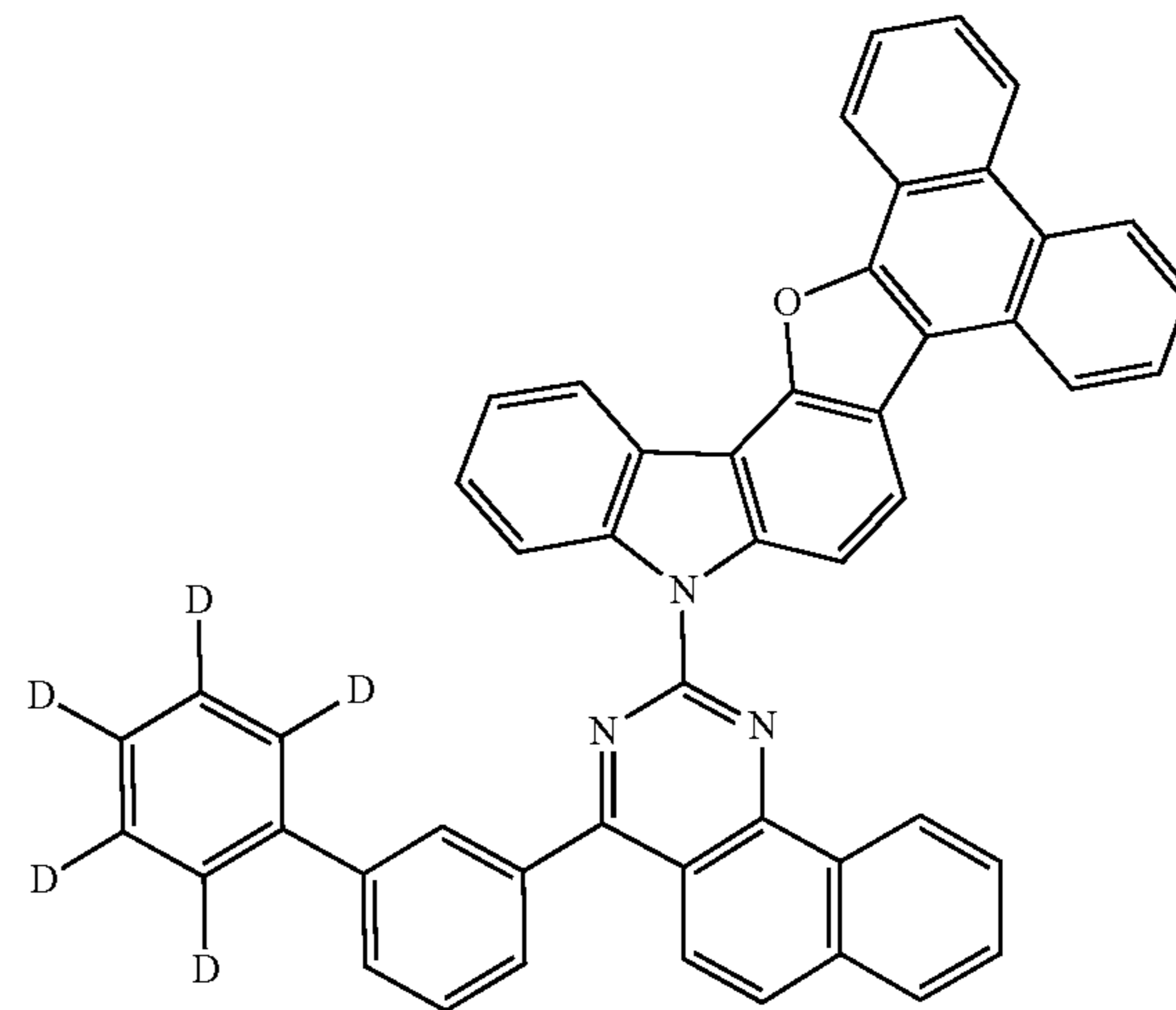
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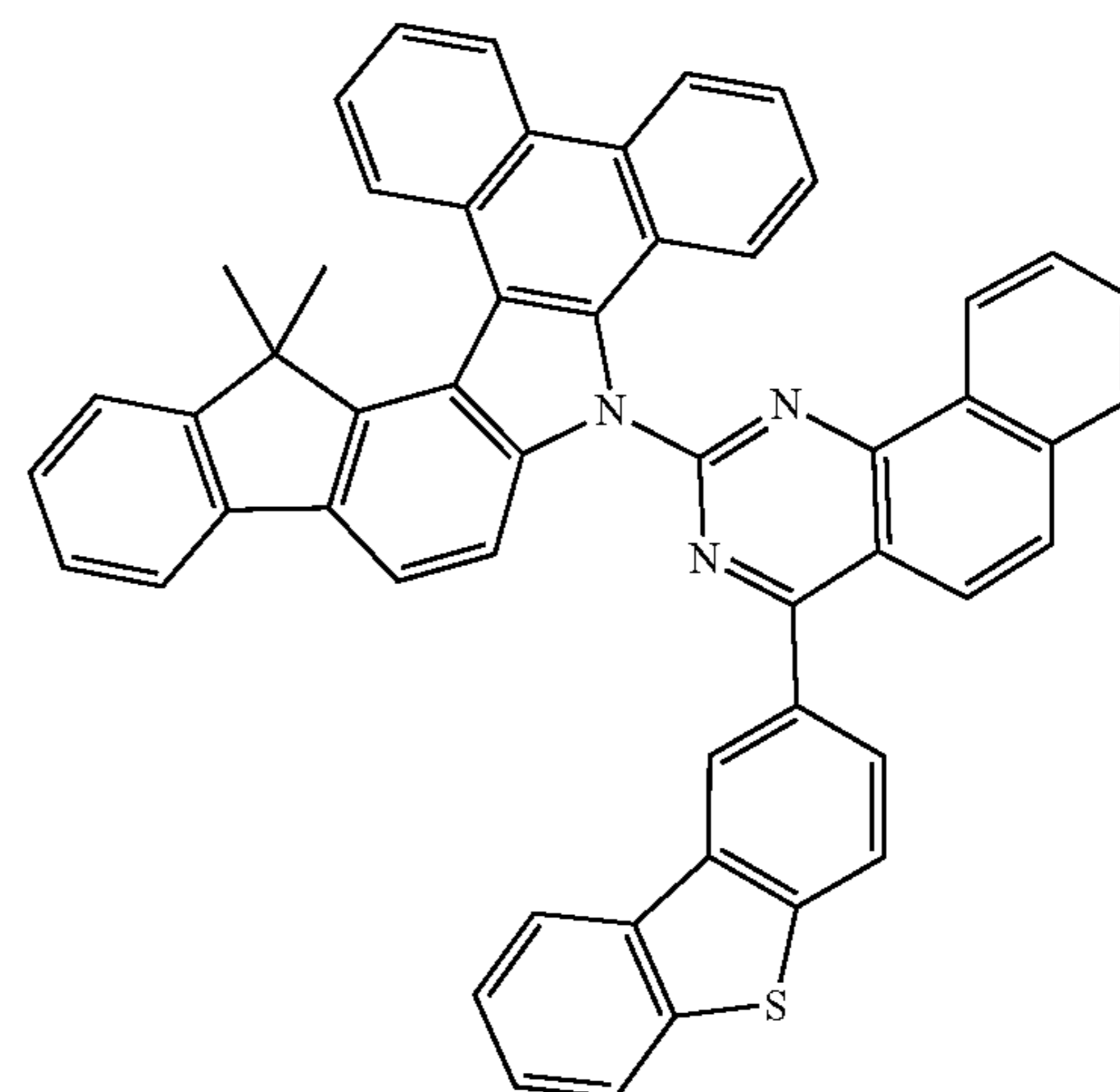
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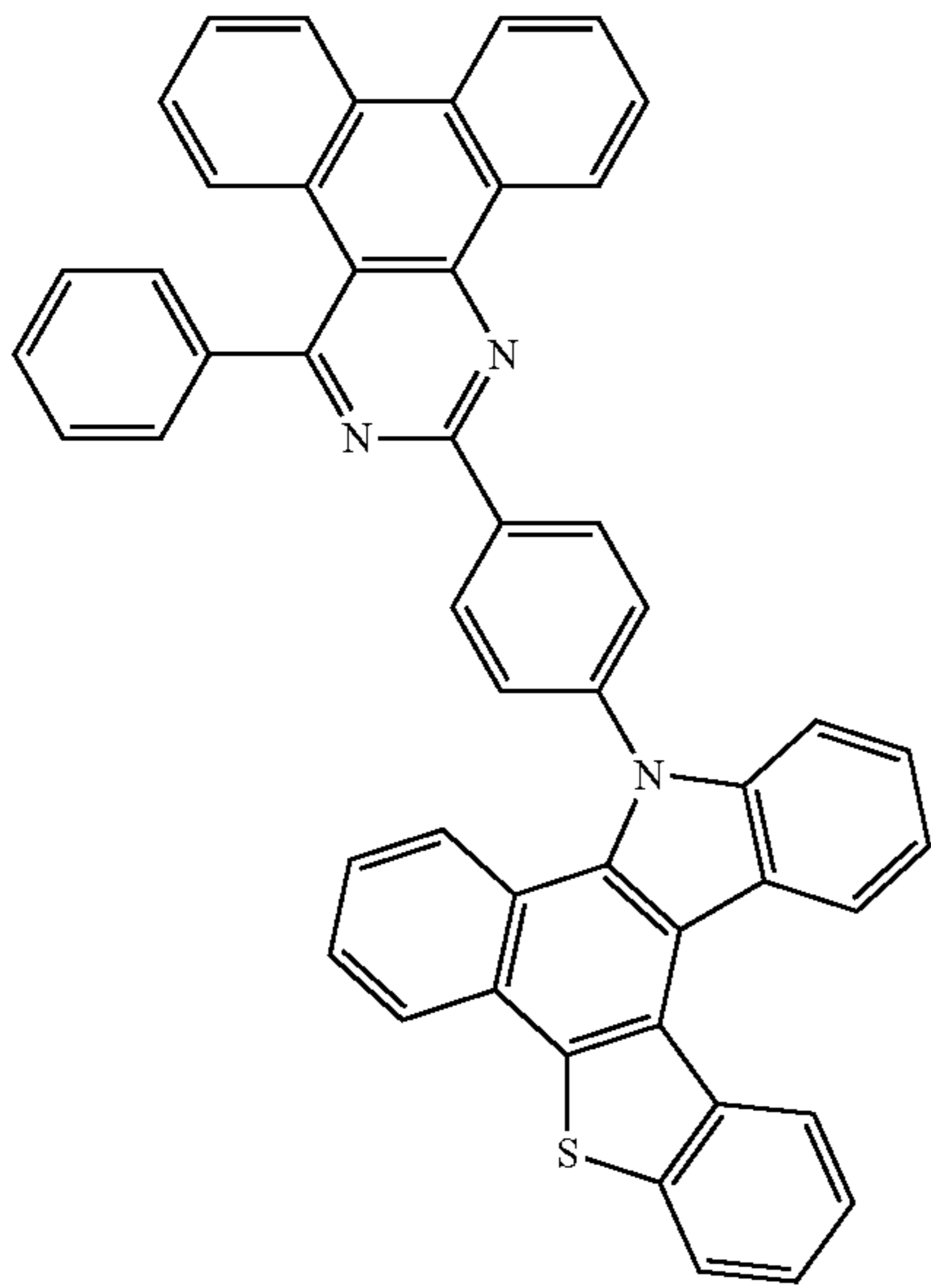


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3-73

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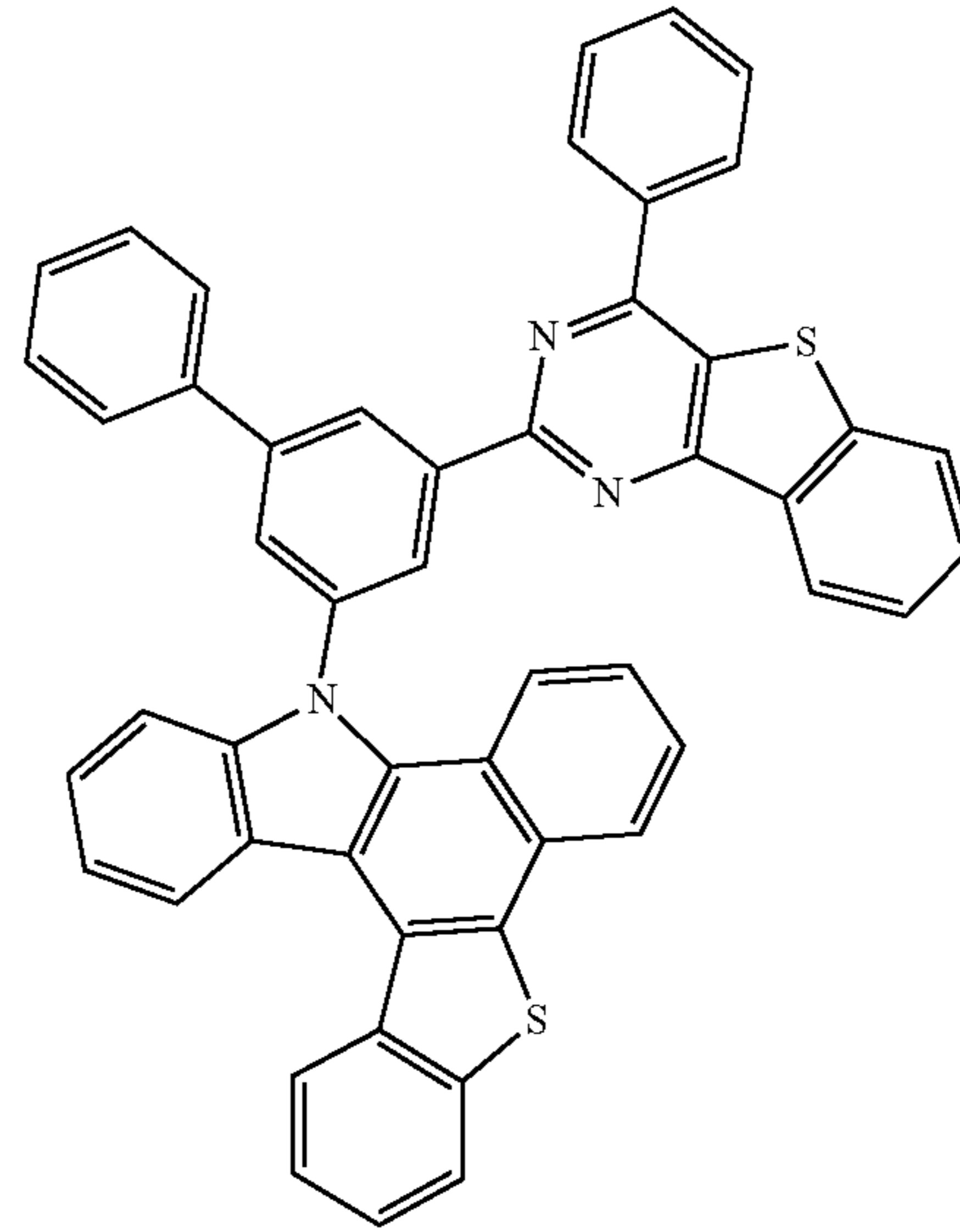
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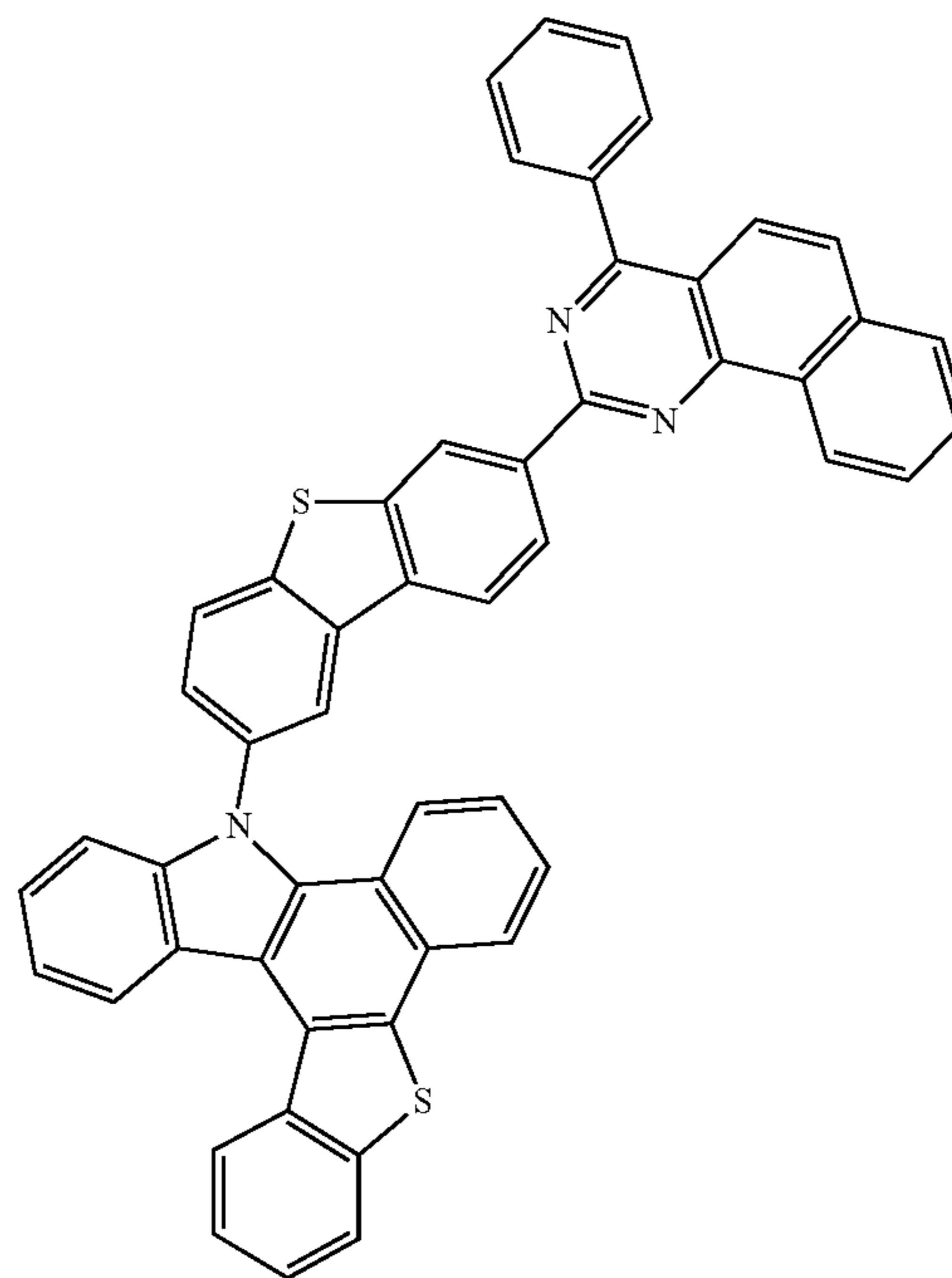
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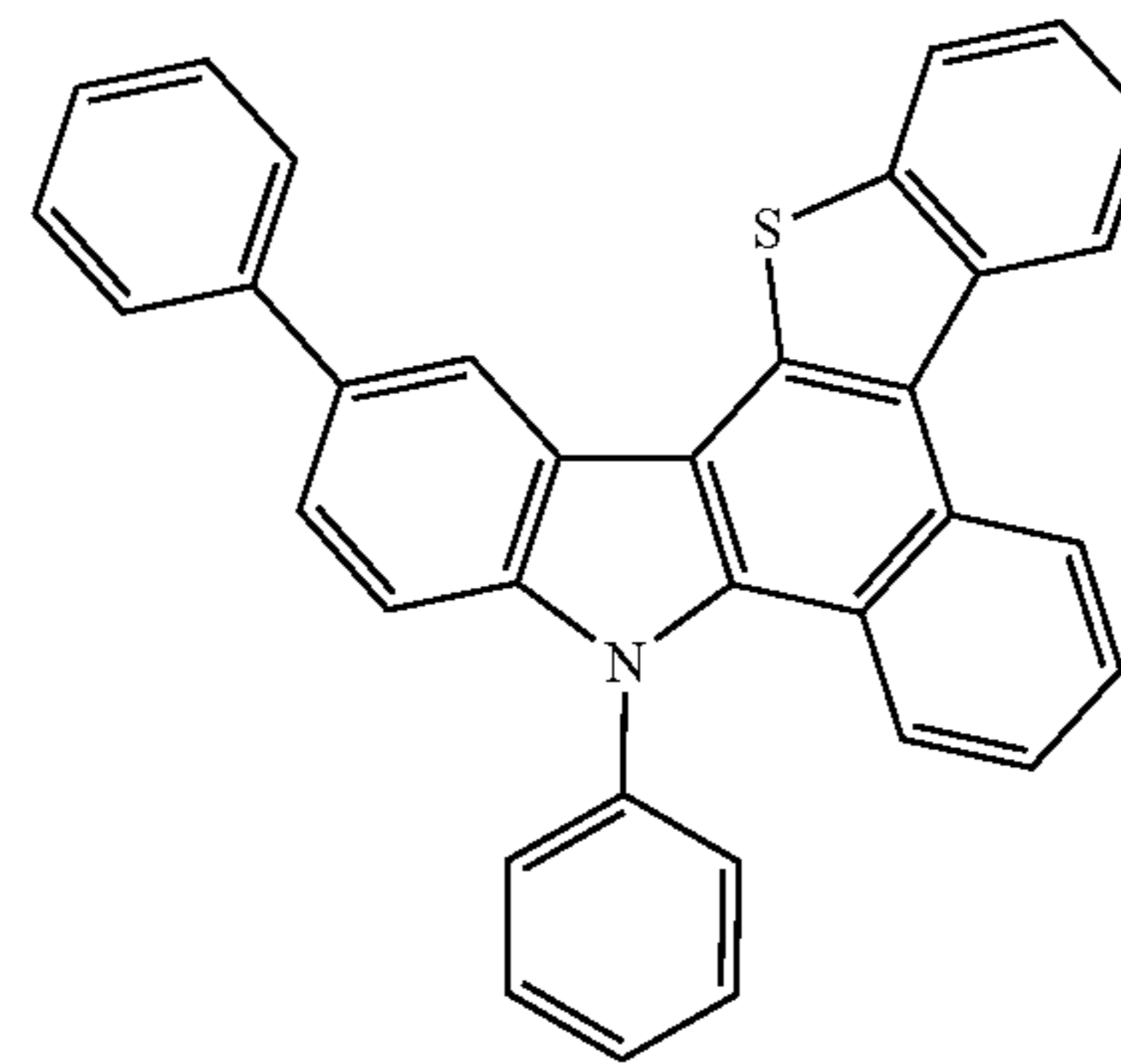
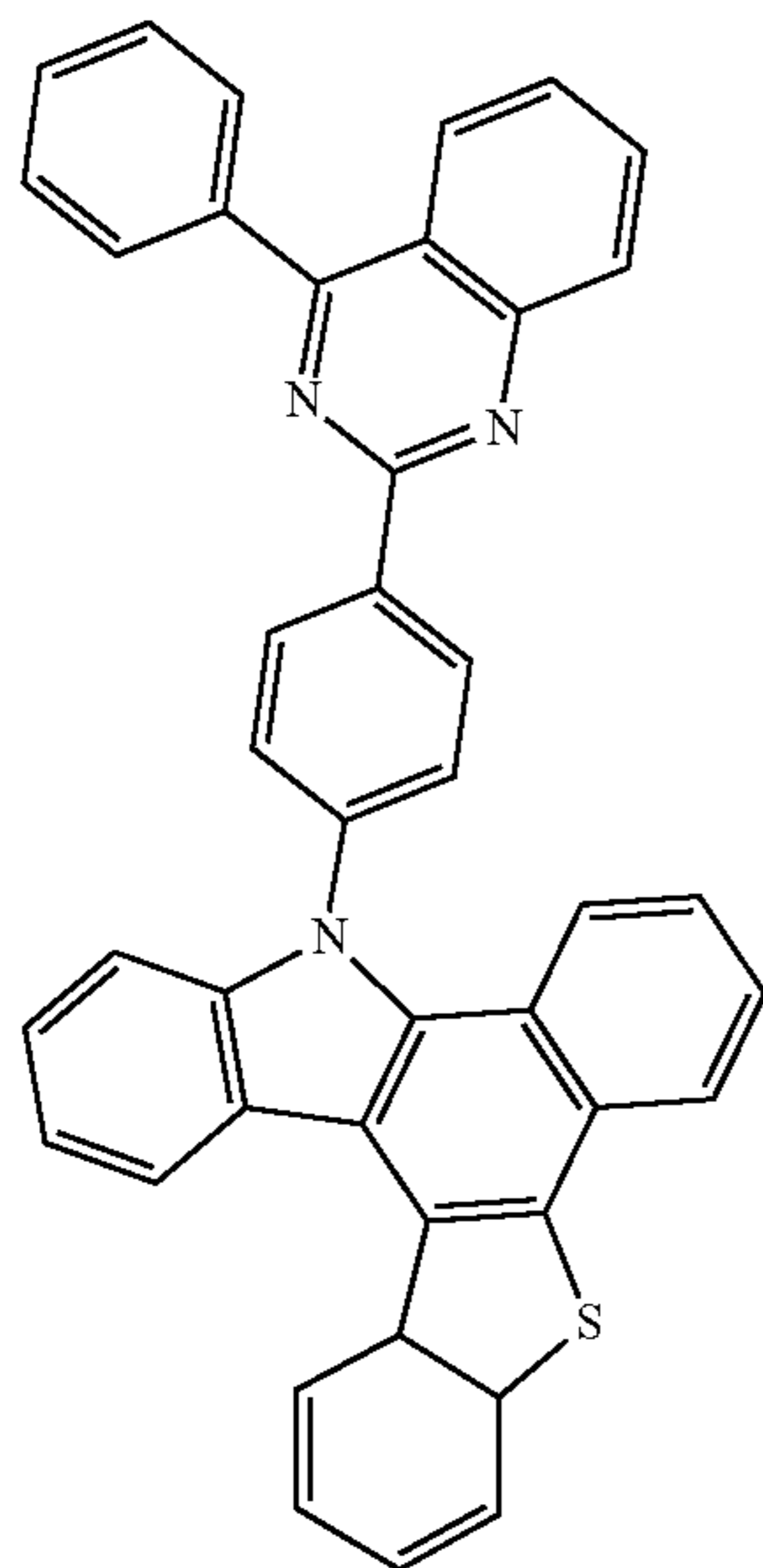
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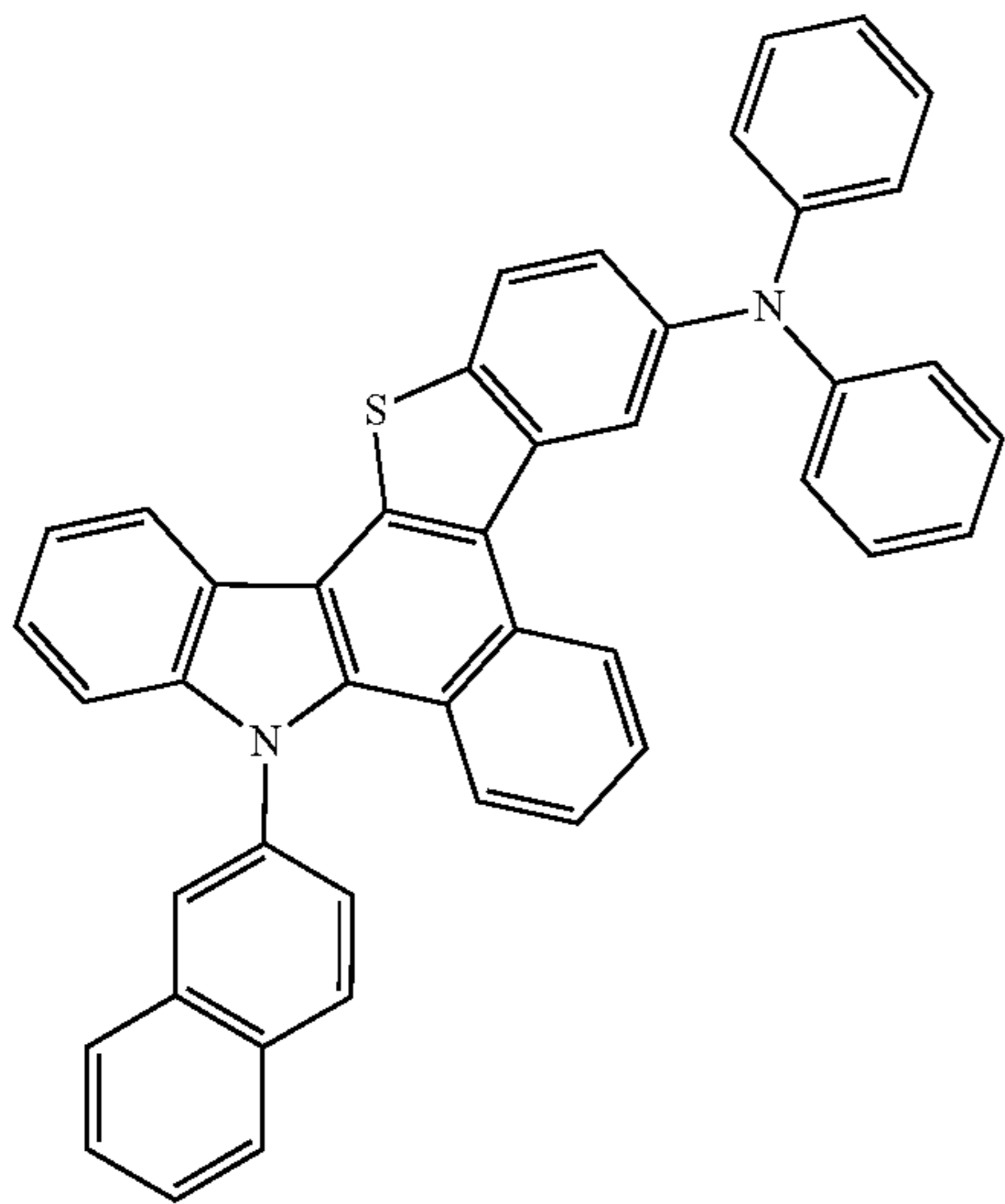
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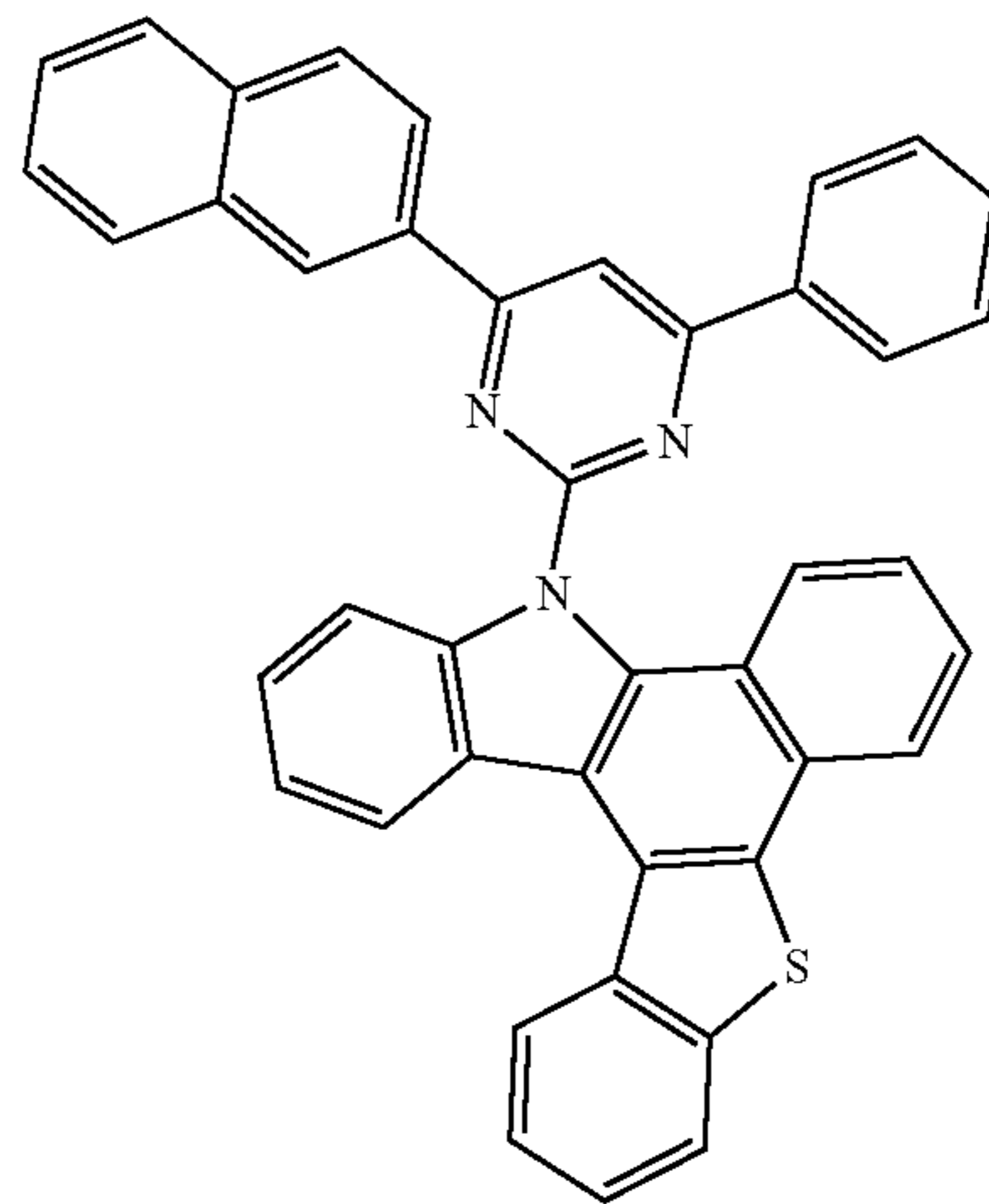
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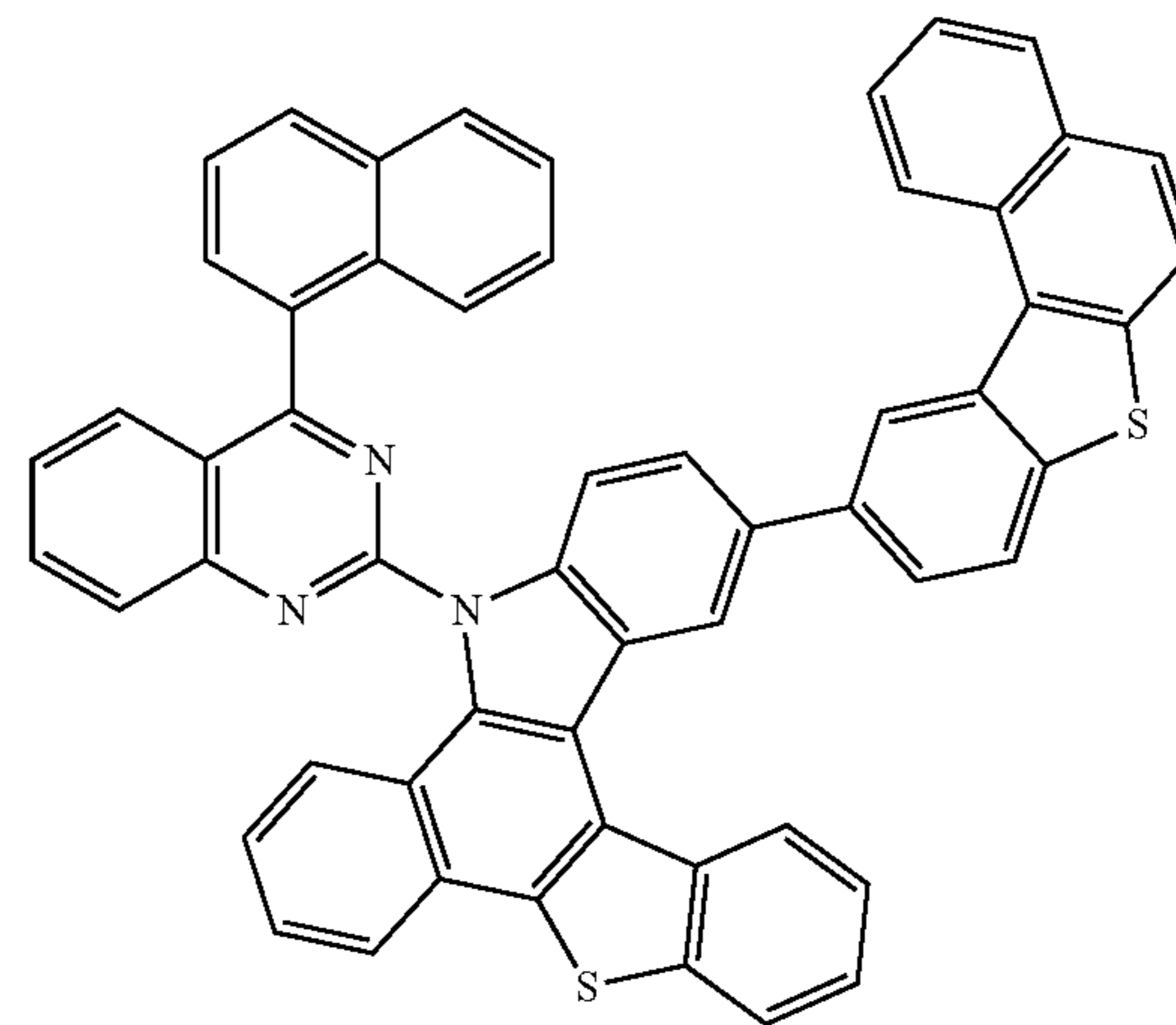
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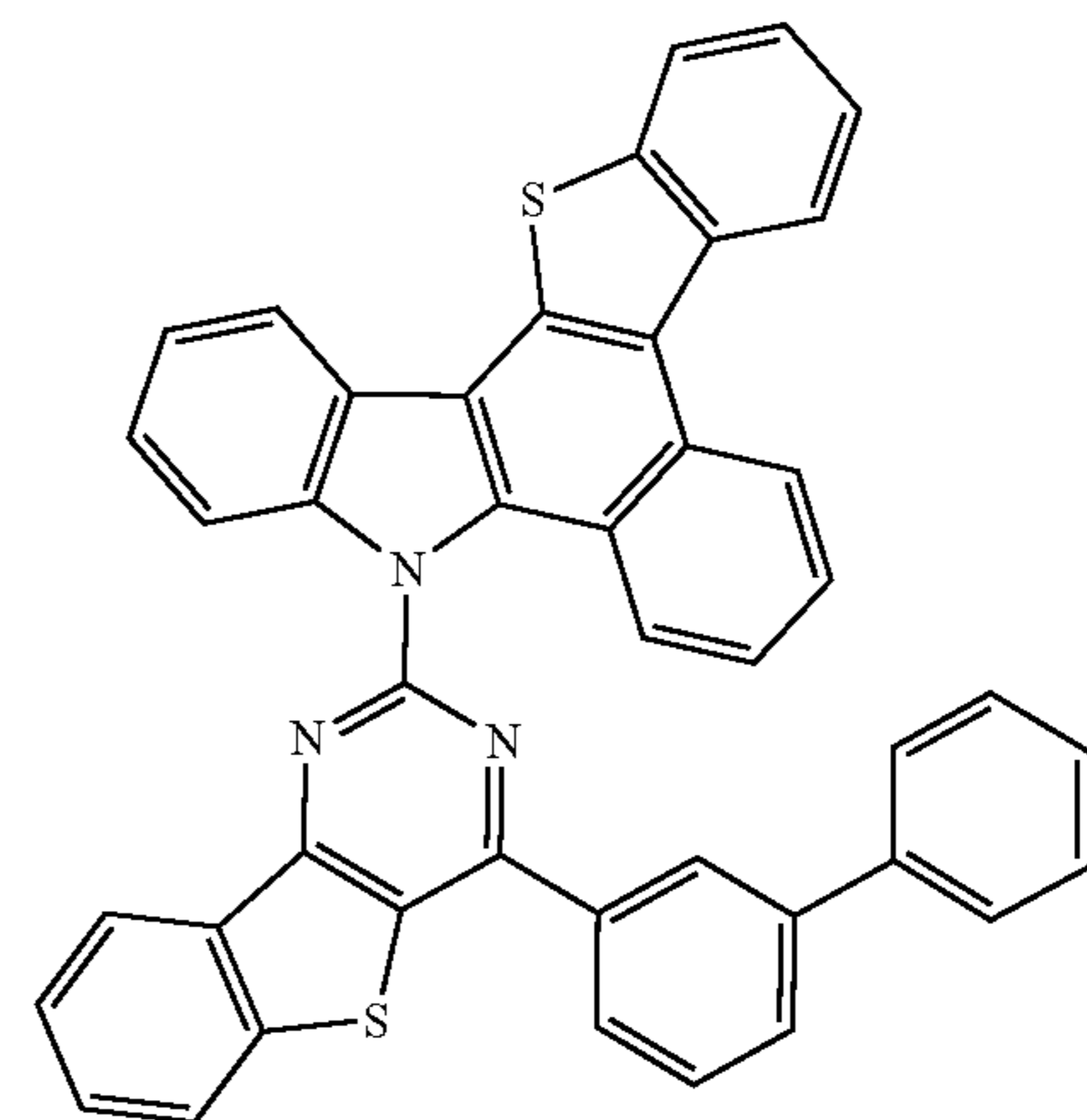
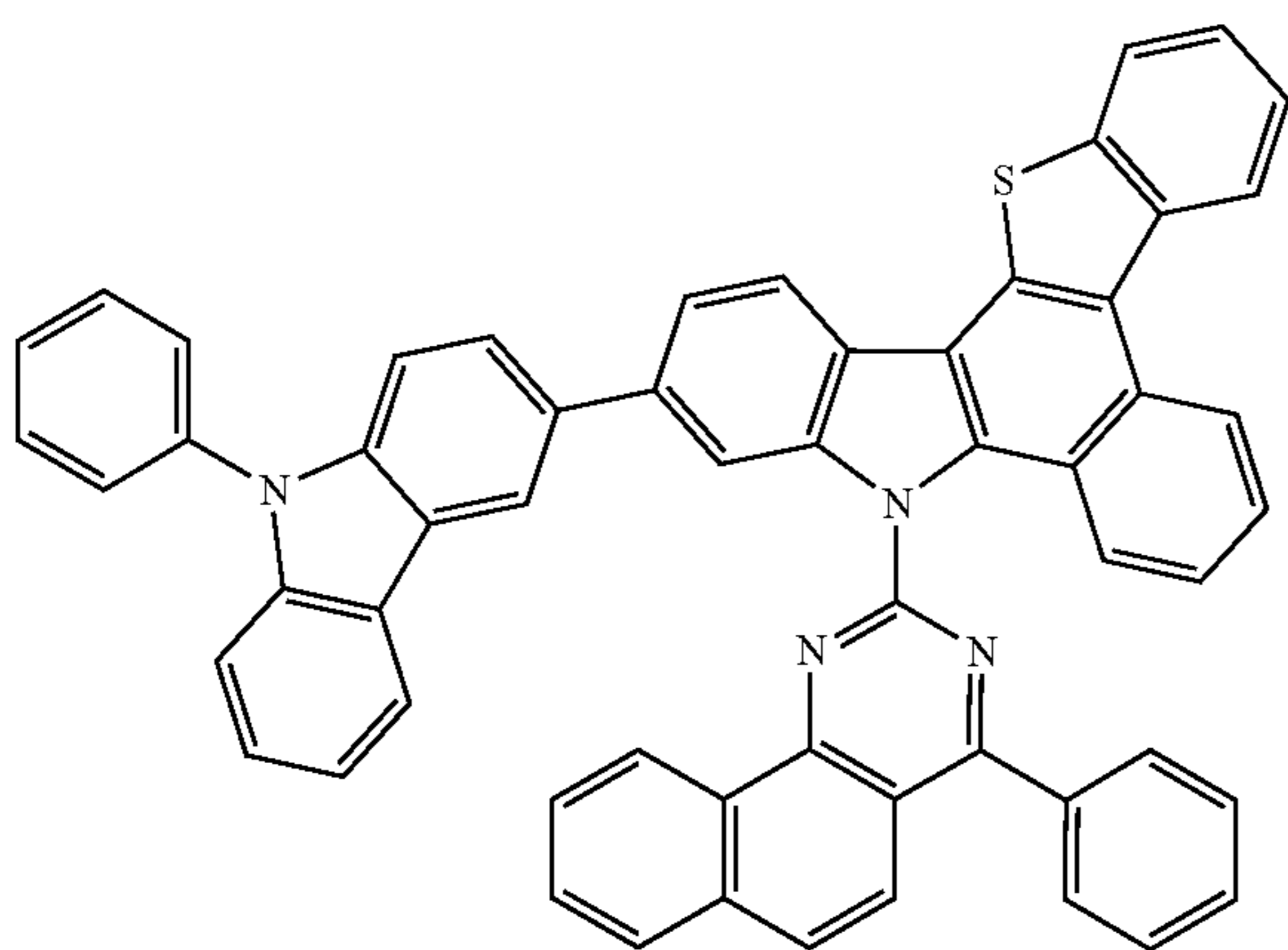
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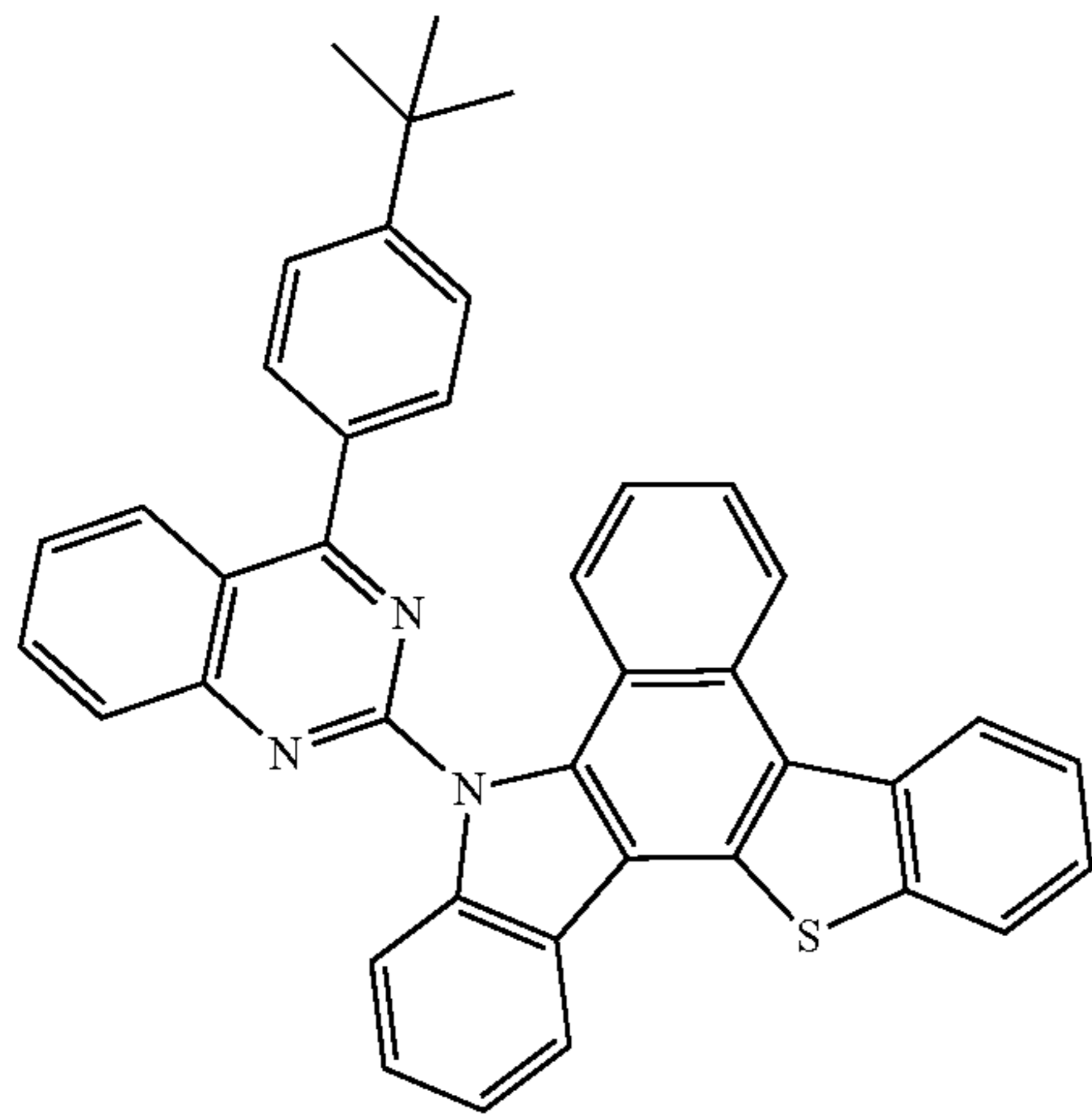
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3-84

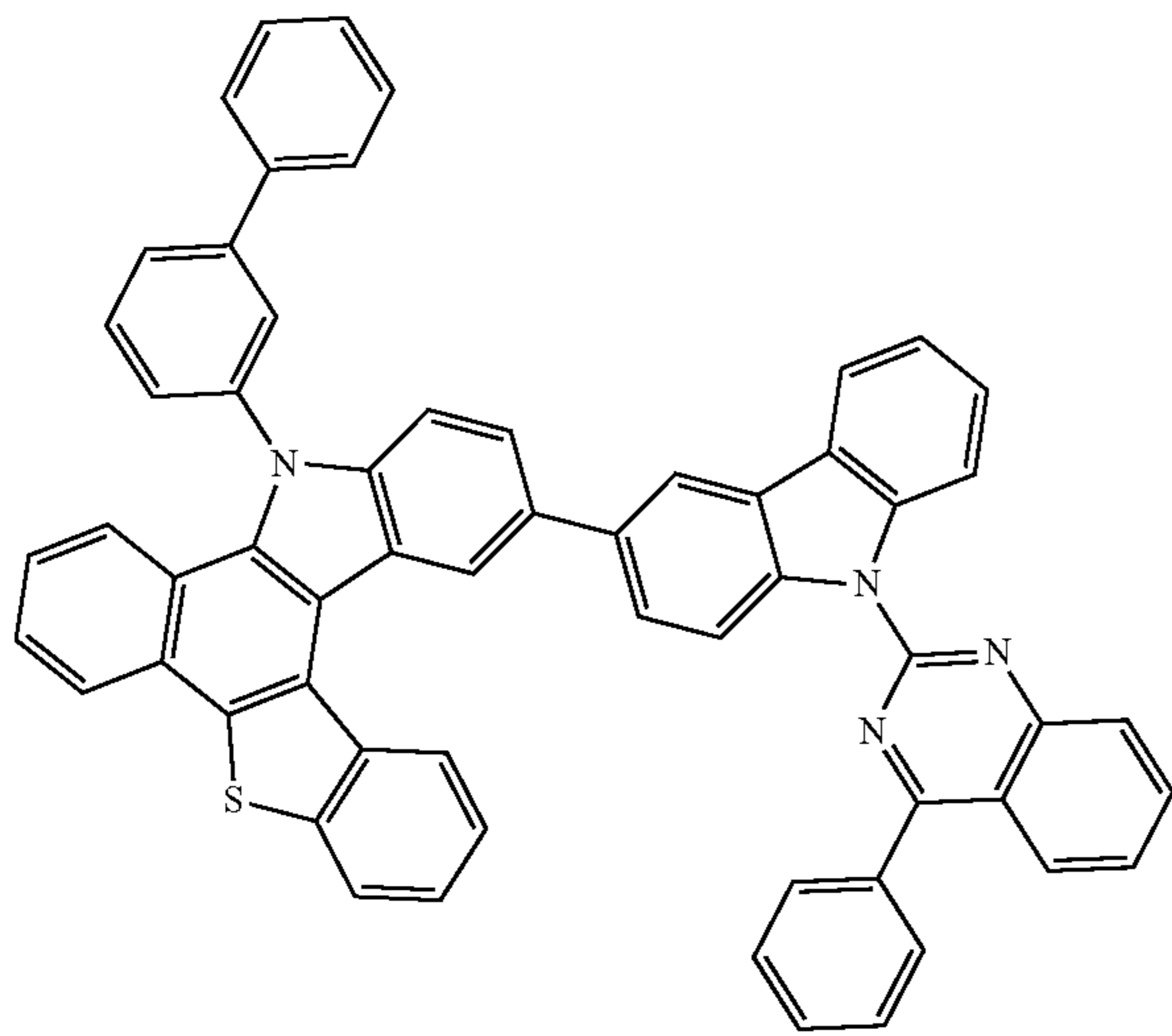
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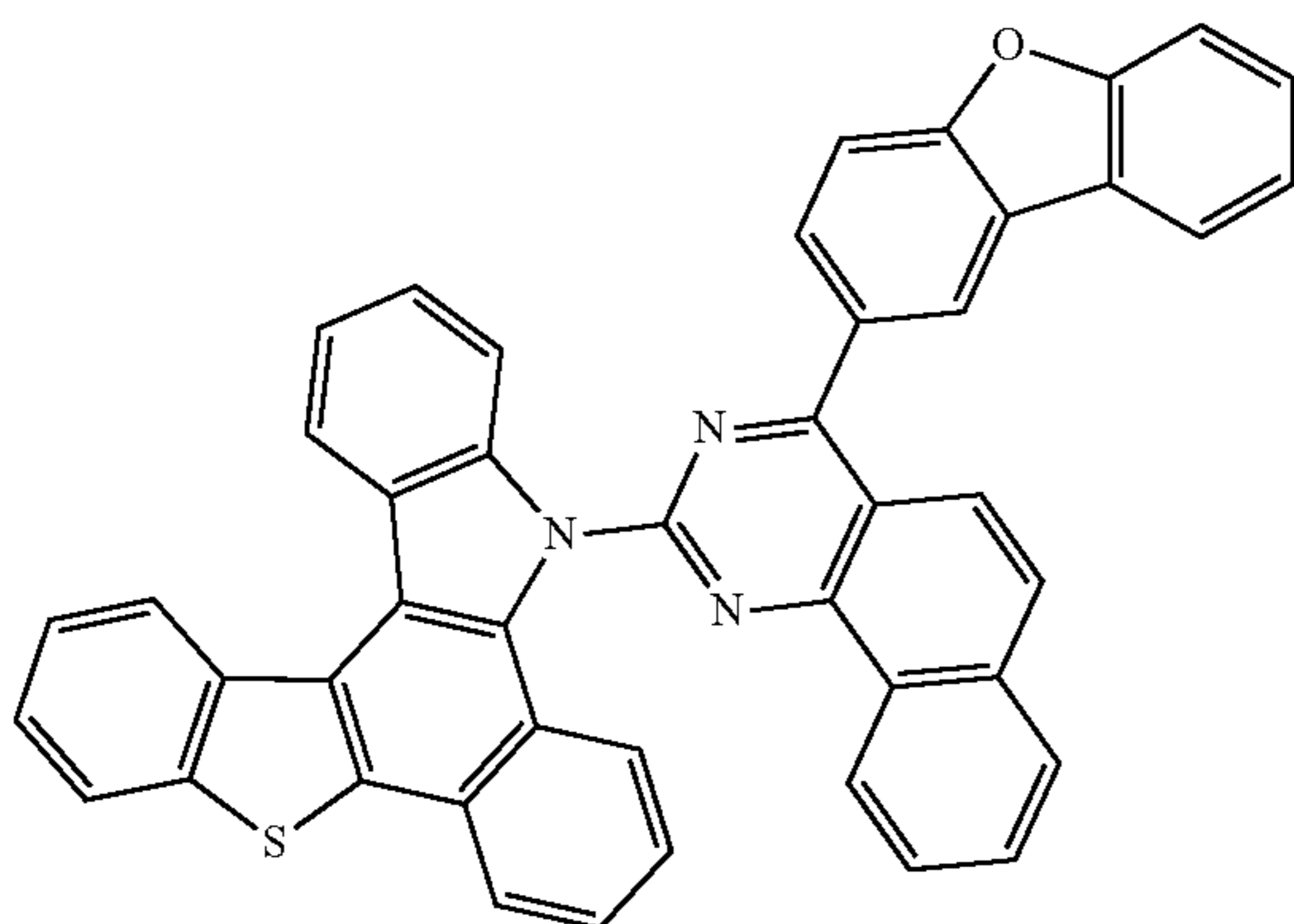
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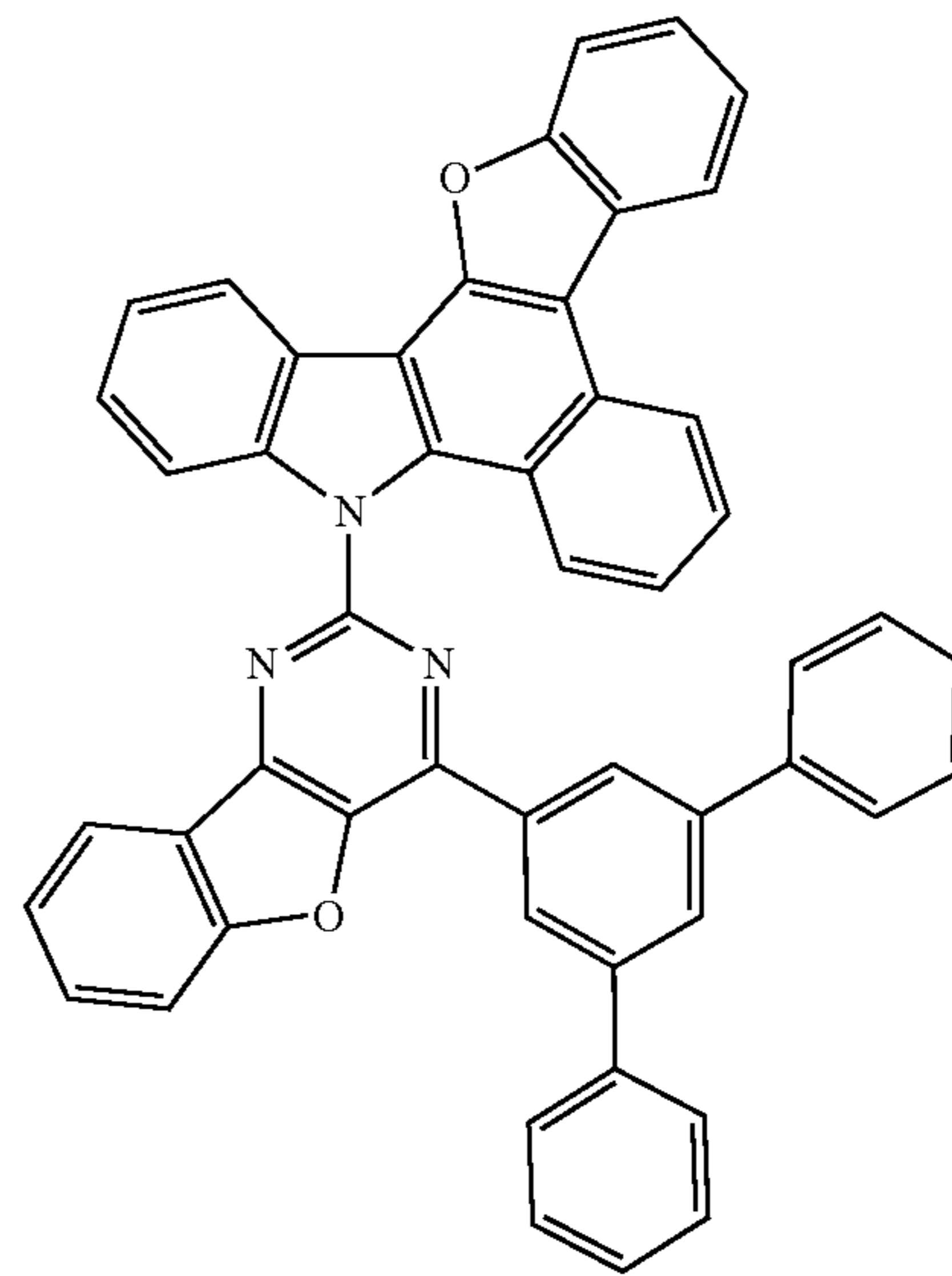
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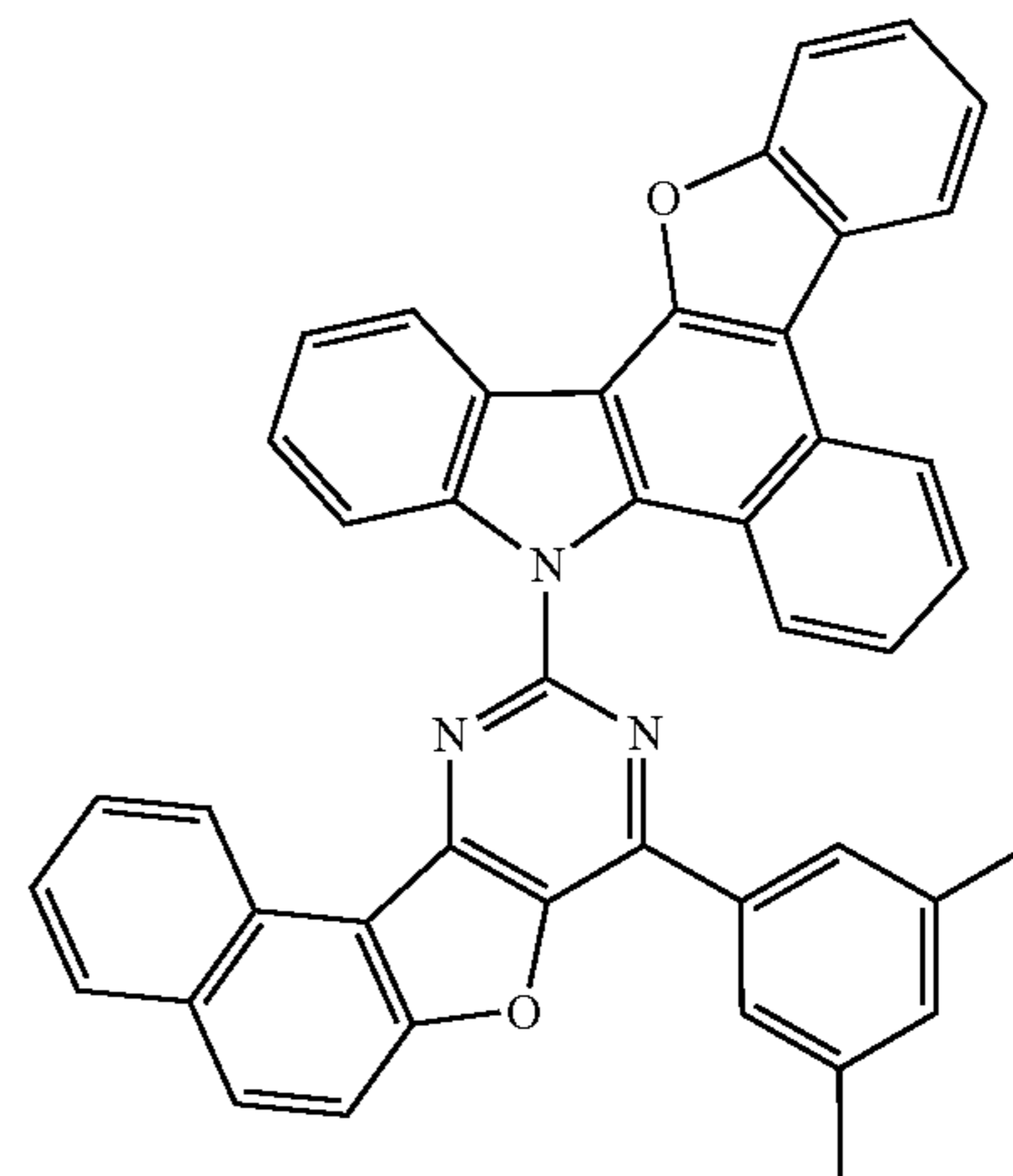
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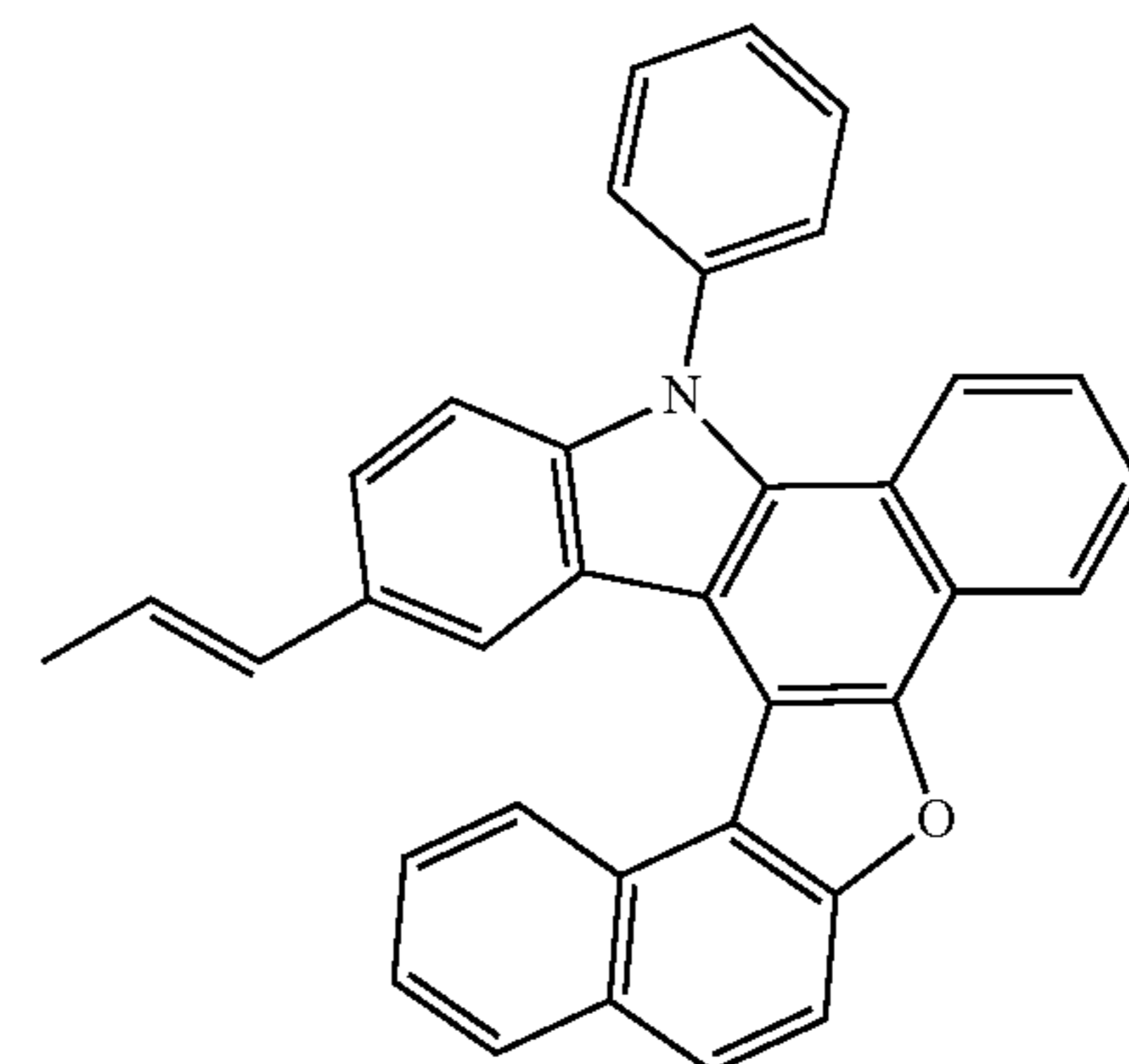
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3-88



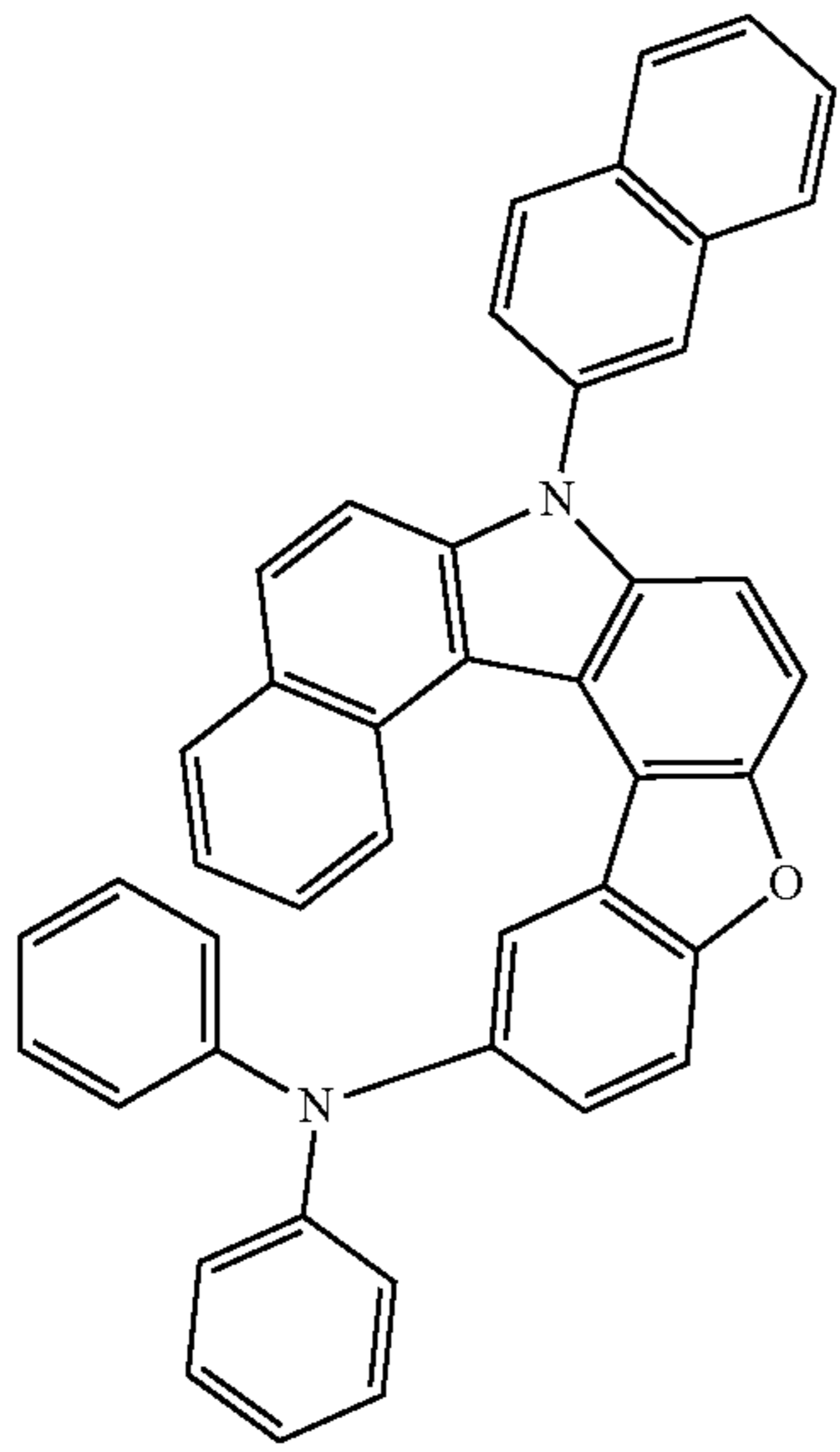
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3-89



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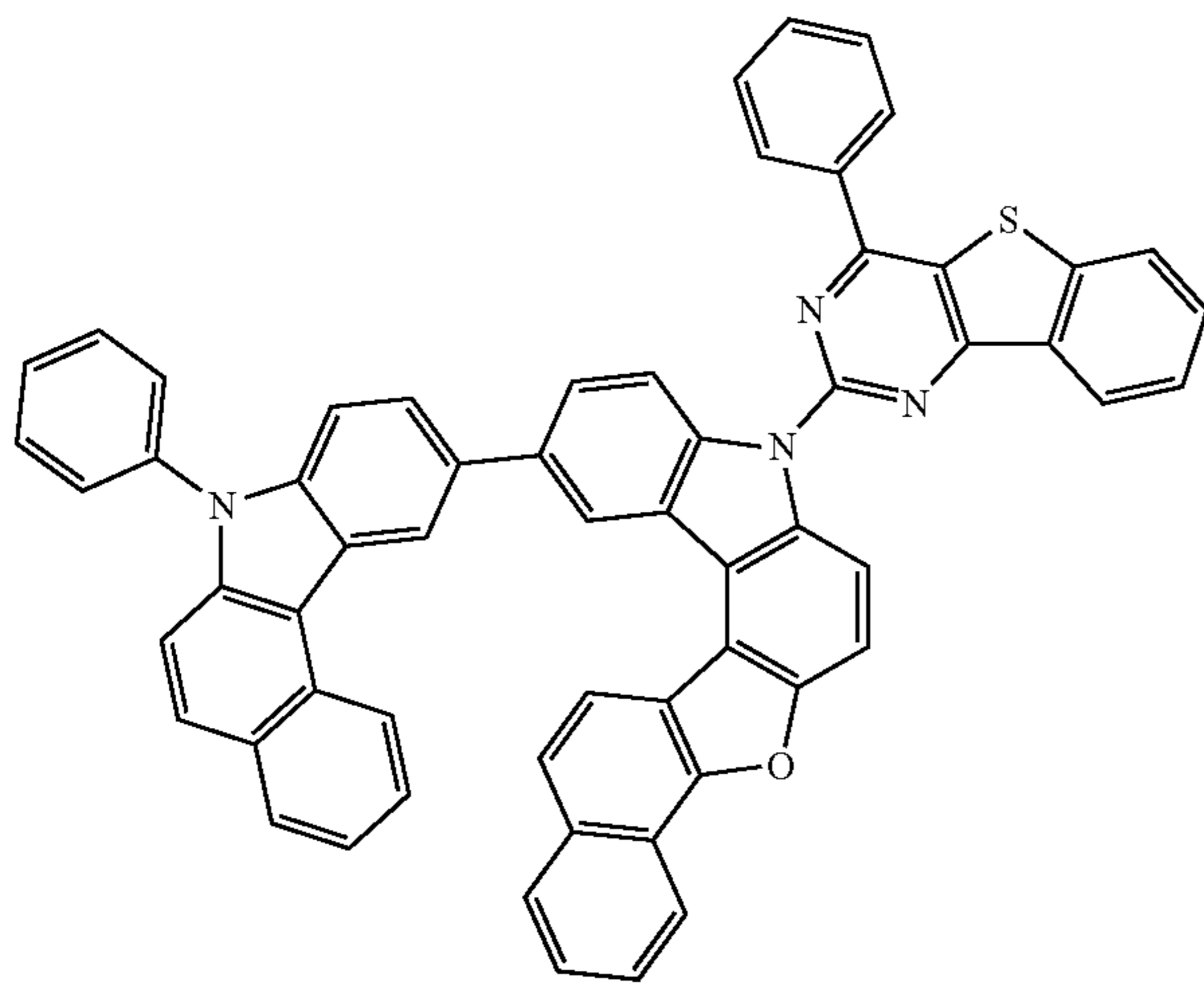
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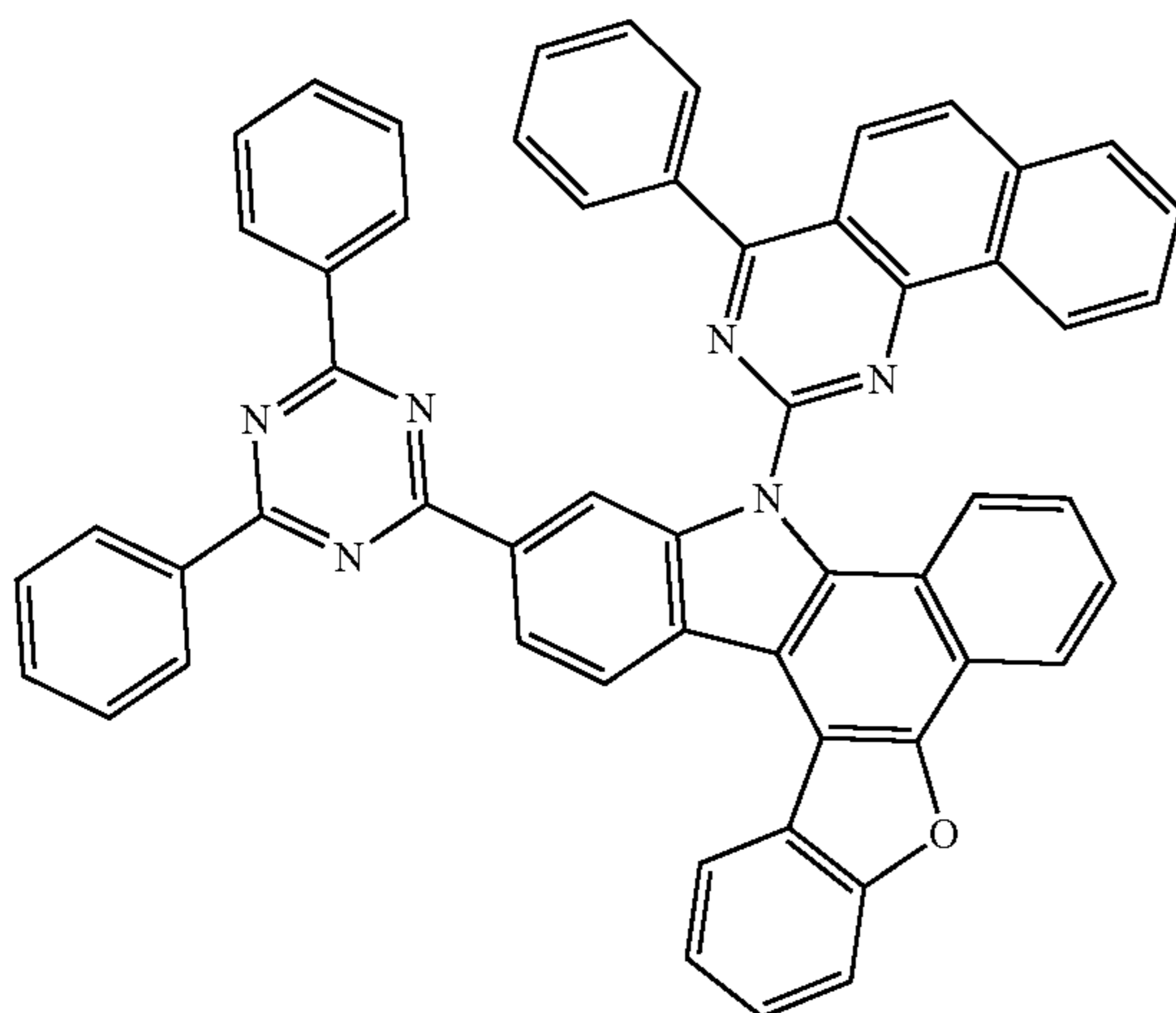
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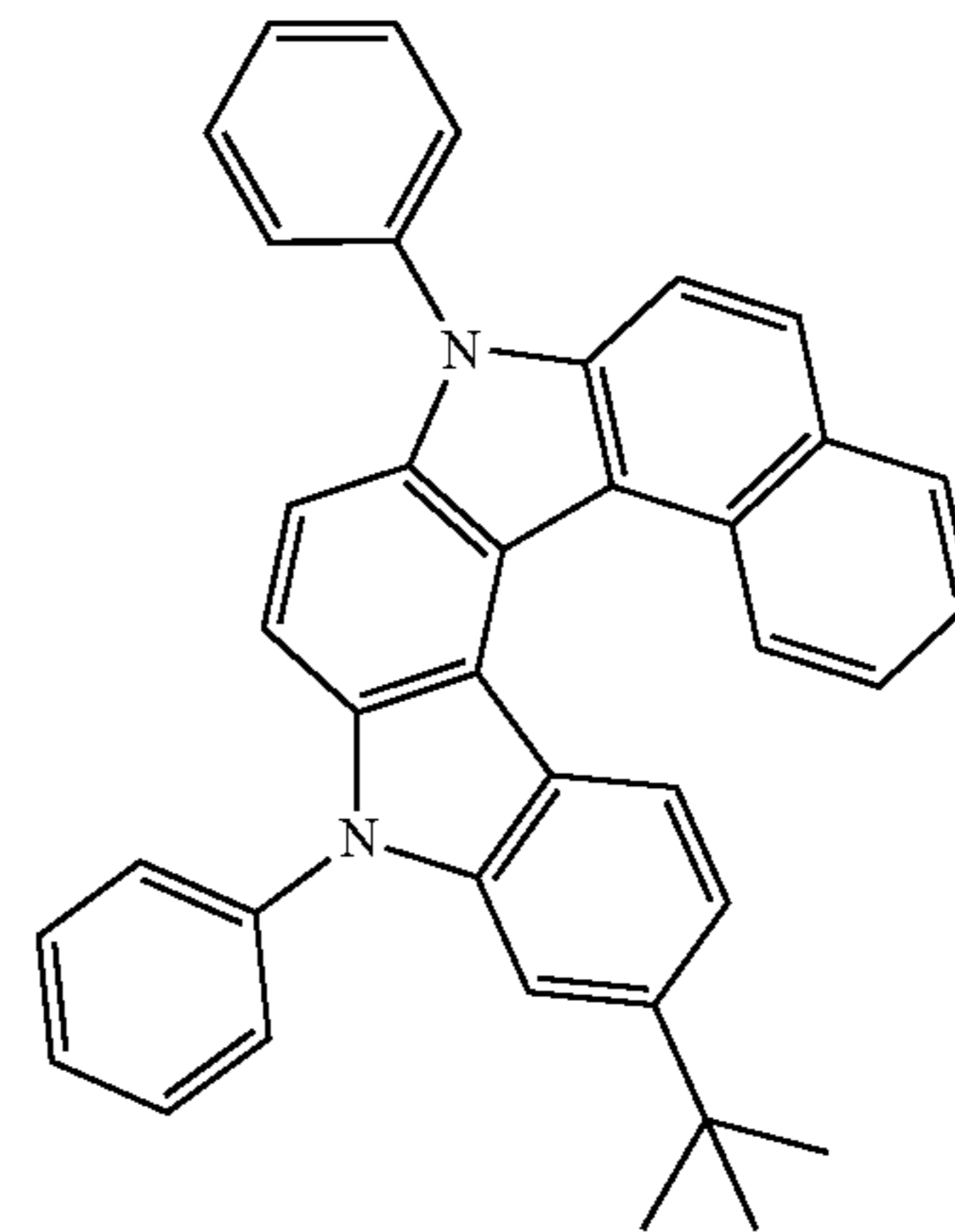
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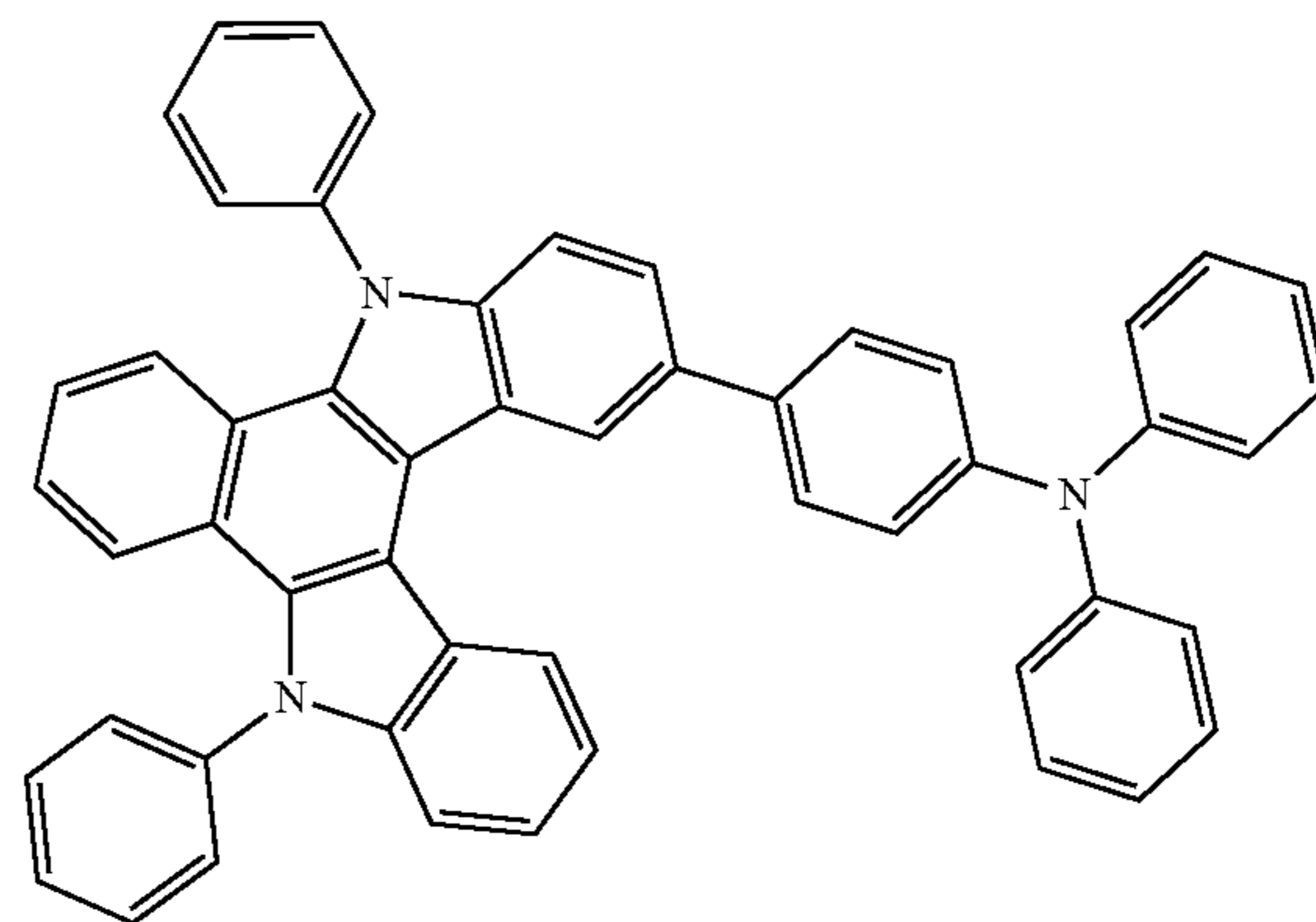
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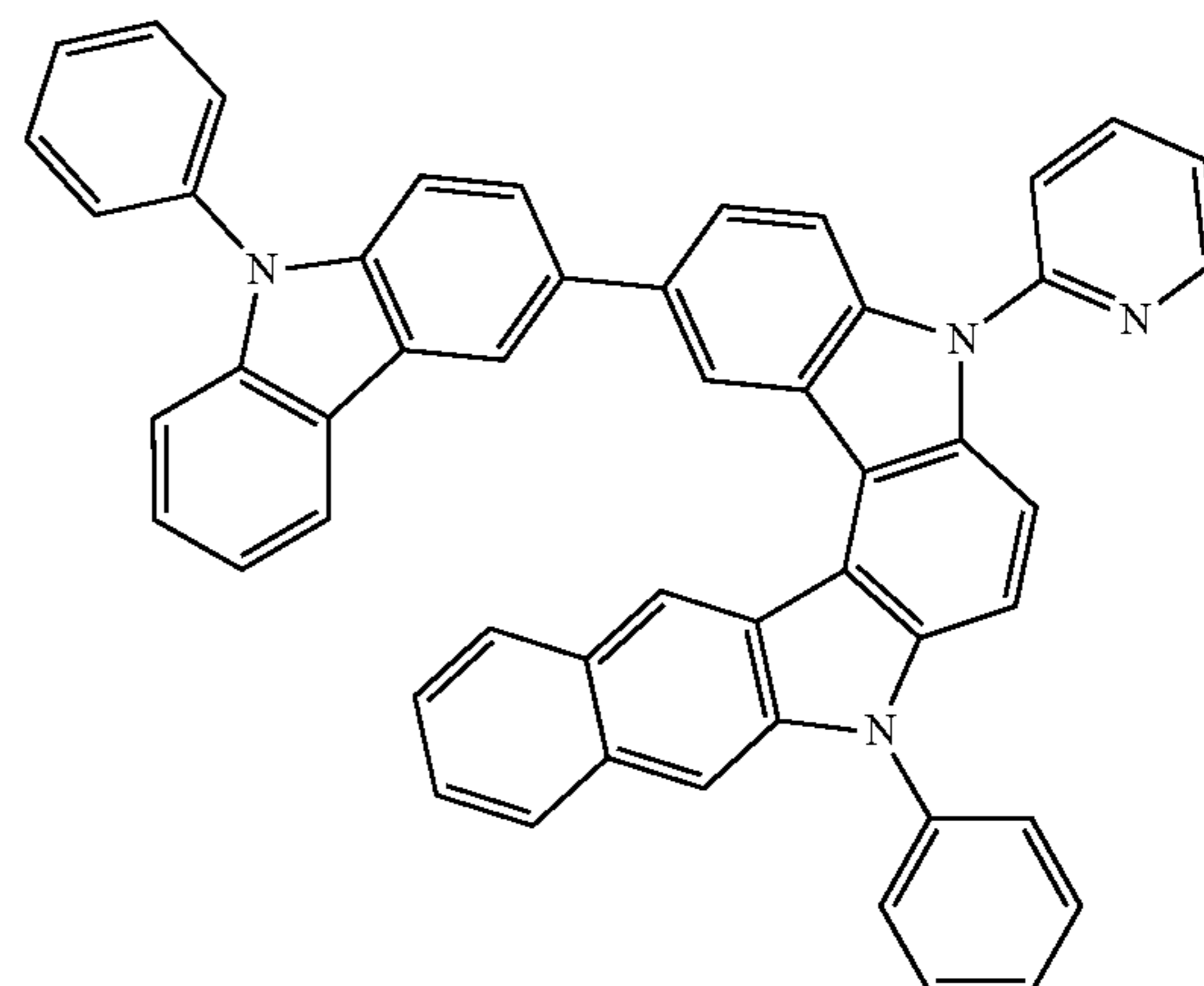


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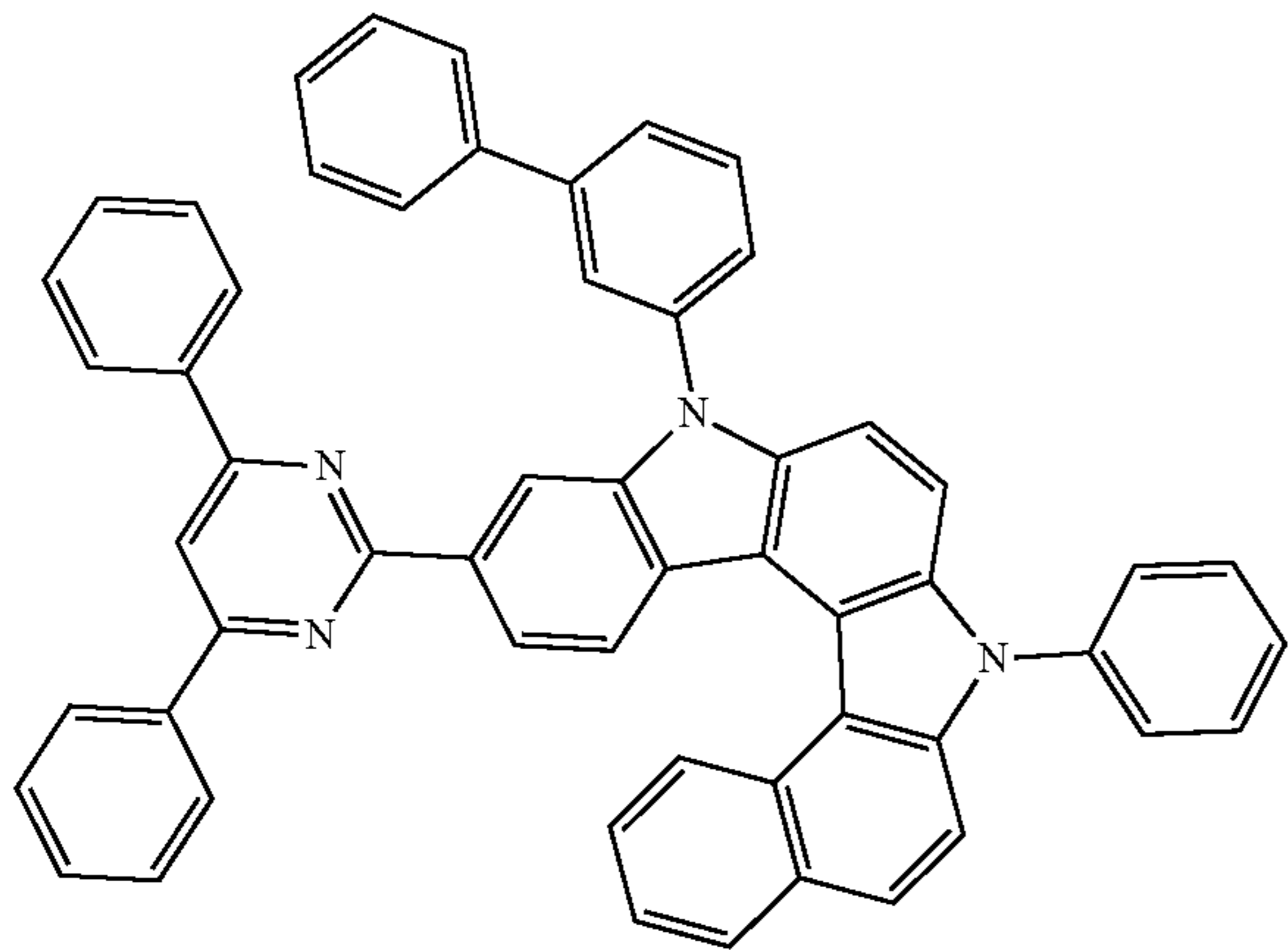
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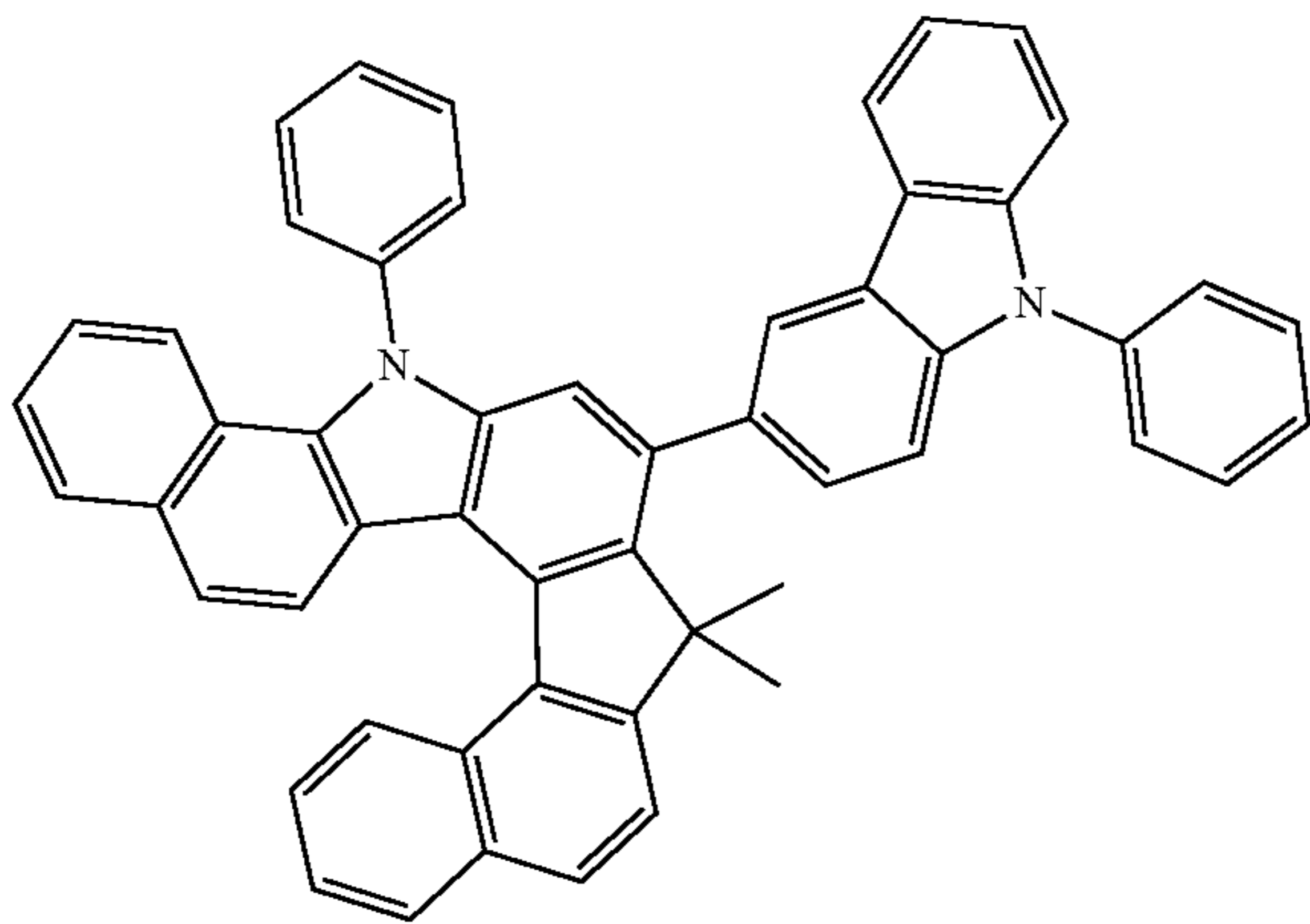
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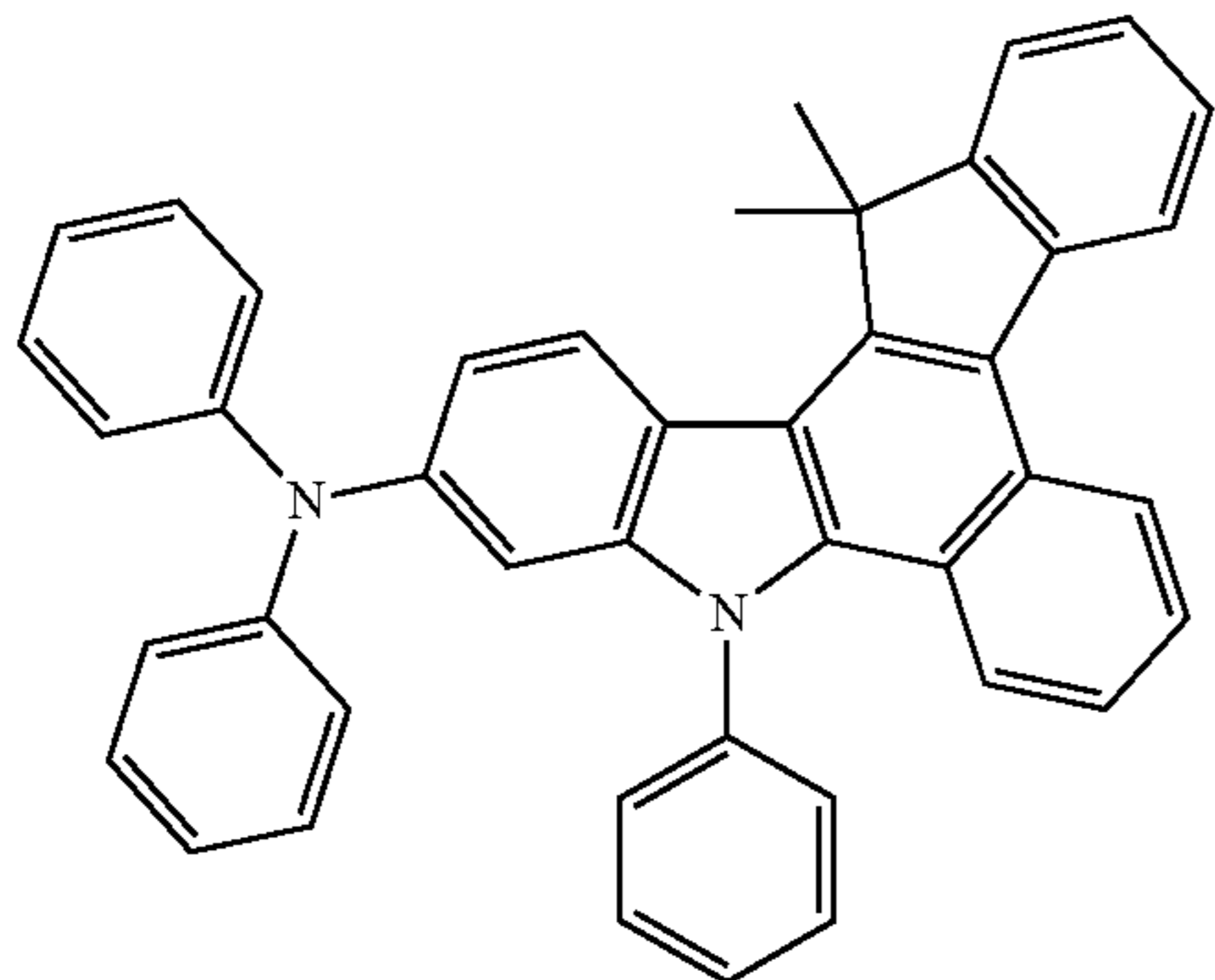
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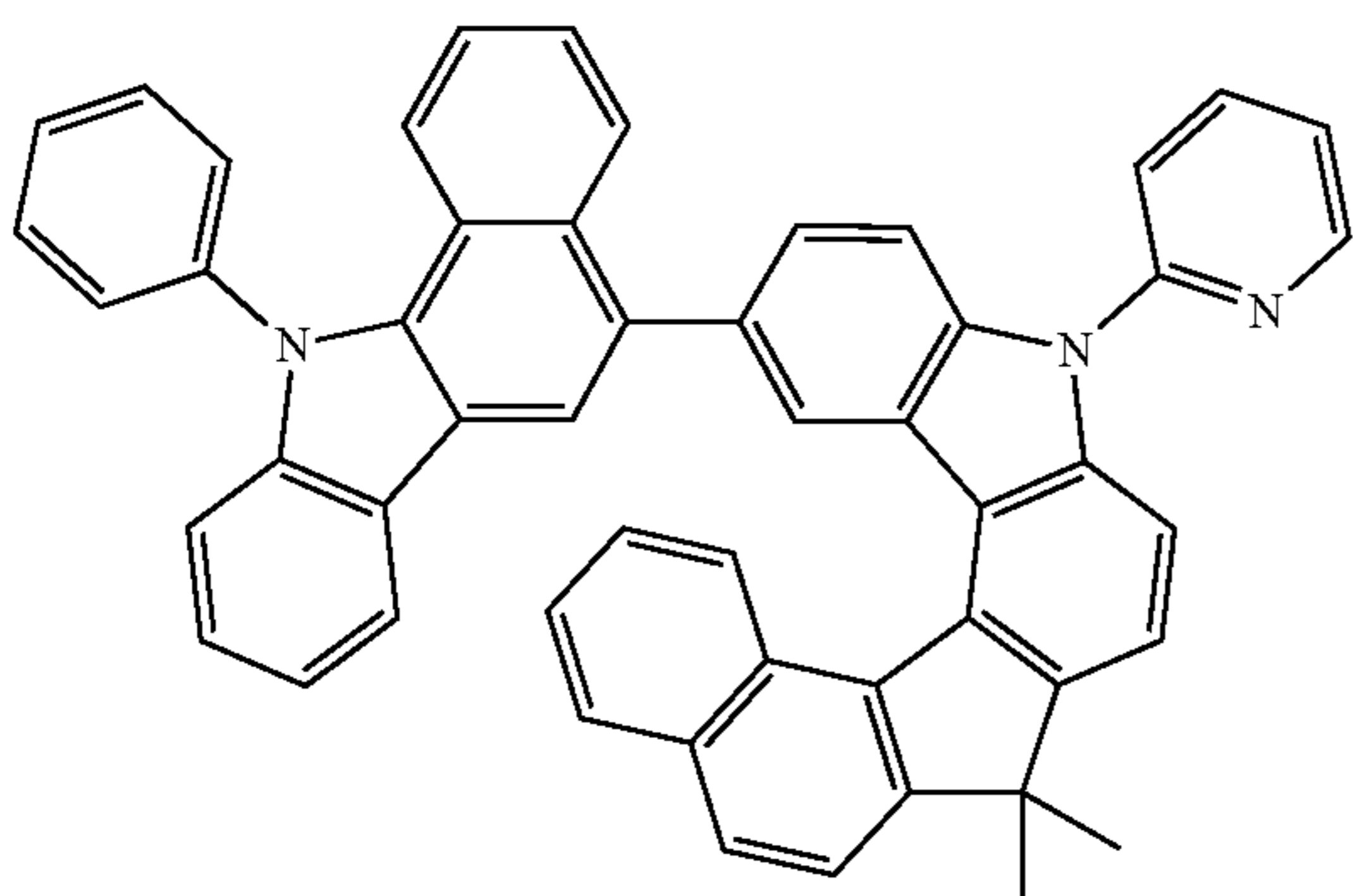
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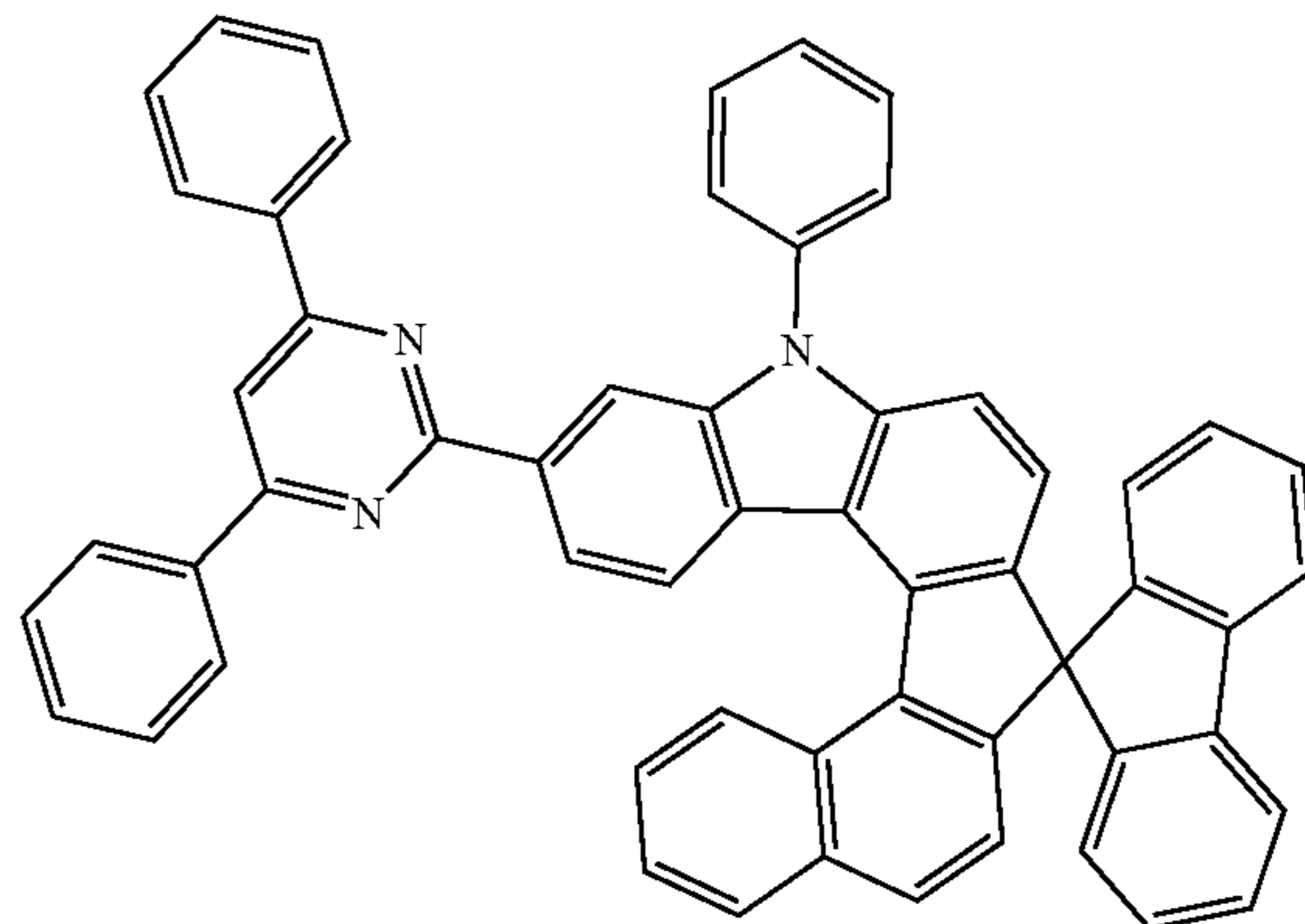
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Referring to the FIGURE, the organic electric element (100) according to the present invention includes a first electrode (120) formed on a substrate (110), a second electrode (180), and an organic material layer including the compound represented by Formula (1) between the first electrode (120) and the second electrode (180). Here, the first electrode (120) may be an anode (positive electrode), and the second electrode (180) may be a cathode (negative electrode). In the case of an inverted organic electric element, the first electrode may be a cathode, and the second electrode may be an anode.

The organic material layer may include a hole injection layer (130), a hole transport layer (140), an emitting layer (150), an electron transport layer (160), and an electron injection layer (170) formed in sequence on the first electrode (120). Here, the remaining layers except the emitting layer (150) may not be formed. The organic material layer may further include a hole blocking layer, an electron blocking layer, an emitting-auxiliary layer (151), an electron transport auxiliary layer, a buffer layer (141), etc., and the electron transport layer (160) and the like may serve as a hole blocking layer.

Although not shown, the organic electric element according to the present invention may further include a protective layer formed on at least one side of the first and second electrodes, which is a side opposite to the organic material layer.

Otherwise, even if the same core is used, the band gap, the electrical characteristics, the interface characteristics, and the like may vary depending on which substituent is bonded at which position, therefore the choice of core and the combination of sub-substituents associated therewith is also very important, and in particular, when the optimal combination of energy levels and T1 values and unique properties of materials (mobility, interfacial characteristics, etc.) of each organic material layer is achieved, a long life span and high efficiency can be achieved at the same time.

The organic electroluminescent device according to an embodiment of the present invention may be manufactured using a PVD (physical vapor deposition) method. For example, a metal or a metal oxide having conductivity or an alloy thereof is deposited on a substrate to form a cathode, and the organic material layer including the hole injection layer (130), the hole transport layer (140), the emitting layer (150), the electron transport layer (160), and the electron injection layer (170) is formed thereon, and then depositing a material usable as a cathode thereon can manufacture an

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organic electroluminescent device according to an embodiment of the present invention.

In addition, an emission auxiliary layer (151) may be further formed between the hole transport layer (140) and the emitting layer (150), and an electron transport auxiliary layer may be further formed between the emitting layer (150) and the electron transport layer (160).

The present invention may further include a light efficiency enhancing layer formed on at least one of the opposite side to the organic material layer among one side of the first electrode, or one of the opposite side to the organic material layer among one side of the second electrode.

Also, the present invention provides the organic electric element wherein the organic material layer is formed by one of a spin coating process, a nozzle printing process, an inkjet printing process, a slot coating process, a dip coating process or a roll-to-roll process, and since the organic material layer according to the present invention can be formed by various methods, the scope of the present invention is not limited by the method of forming the organic material layer.

As another specific example, the present invention provides an organic electric element wherein the emitting layer in the organic material layer is a phosphorescent light emitting layer.

The compounds represented by Formula (1) and (2) are mixed in a ratio of any one of 1:9 to 9:1 to be included in the emitting layer of the organic material layer.

The compound represented by Formula (1) and (2) are mixed in a ratio of any one of 1:9 to 5:5 to be included in the emitting layer of the organic material layer. More preferably, the mixing ratio of the compound represented by Formula (1) and (2) is 2:8 or 3:7 to be included in the emitting layer.

The organic electric element according to an embodiment of the present invention may be a front emission type, a back emission type, or a both-sided emission type, depending on the material used.

WOLED (White Organic Light Emitting Device) has advantages of high resolution realization and excellent fairness, and can be manufactured using conventional LCD color filter technology. Various structures for a white organic light emitting device mainly used as a backlight device have been proposed and patented. Representatively, there are side-by-side arrangement of the radiation part of the R (red), G (green) and B (blue), a stacking method in which R, G, and B emitting layers are laminated on top and bottom, electroluminescence by the blue (B) organic emitting layer and, by using the light from this, a color conversion material (CCM) method using a photo-luminescence of an inorganic phosphor, etc., and the present invention may be applied to such WOLED.

The present invention also provides an electronic device comprising a display device including the organic electric element; and a control unit for driving the display device.

According to another aspect, the present invention provides a display device wherein the organic electric element is at least one of an OLED, an organic solar cell, an organic photo conductor, an organic transistor (organic TFT) and an element for monochromic or white illumination. Here, the electronic device may be a wired/wireless communication terminal which is currently used or will be used in the future, and covers all kinds of electronic devices including a mobile communication terminal such as a cellular phone, a personal digital assistant (PDA), an electronic dictionary, a point-to-

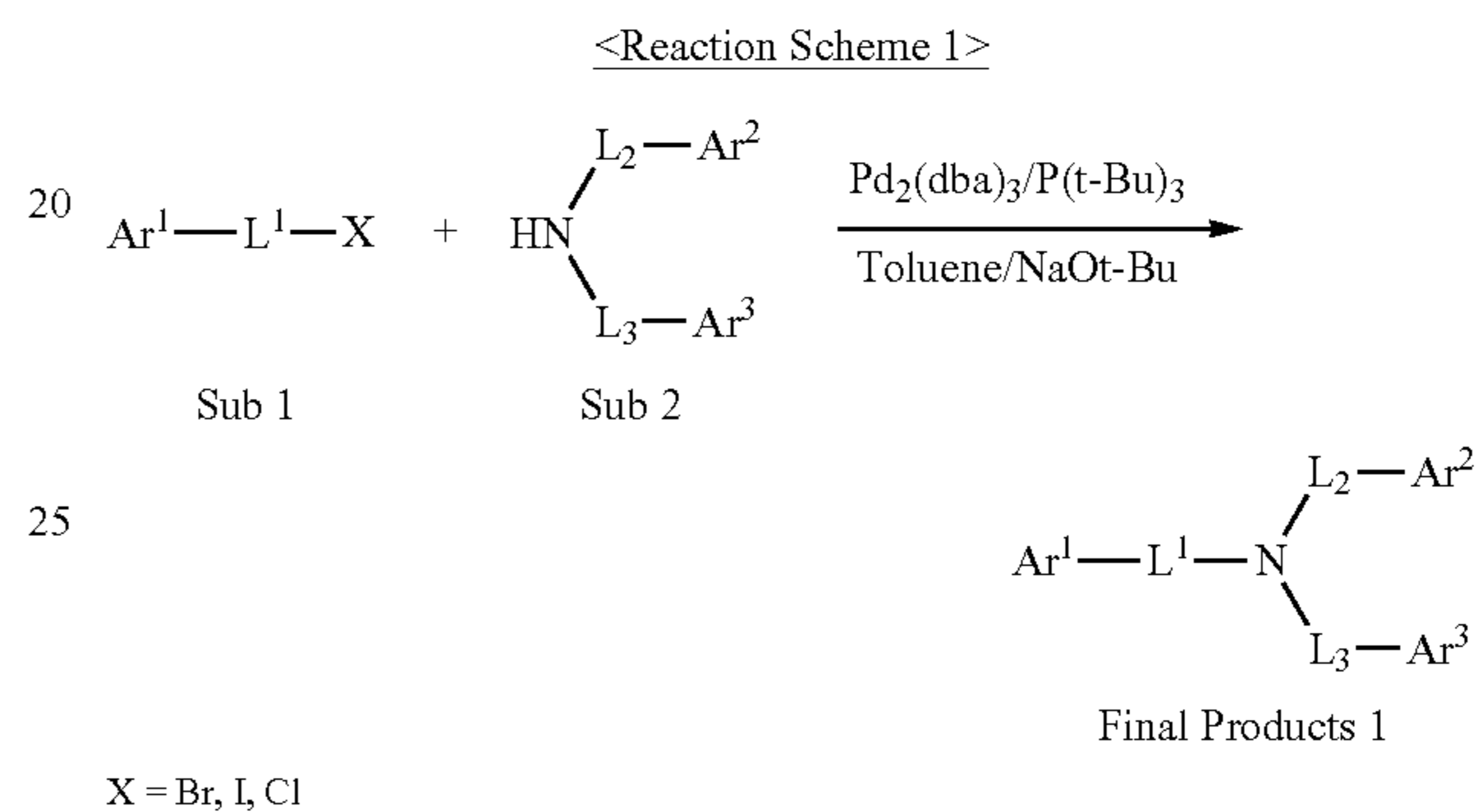
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multipoint (PMP), a remote controller, a navigation unit, a game player, various kinds of TVs, and various kinds of computers.

Hereinafter, Synthesis Examples of the compound represented by Formula (1) and (2) of the present invention and preparation examples of the organic electric element of the present invention will be described in detail by way of example, but are not limited to the following examples.

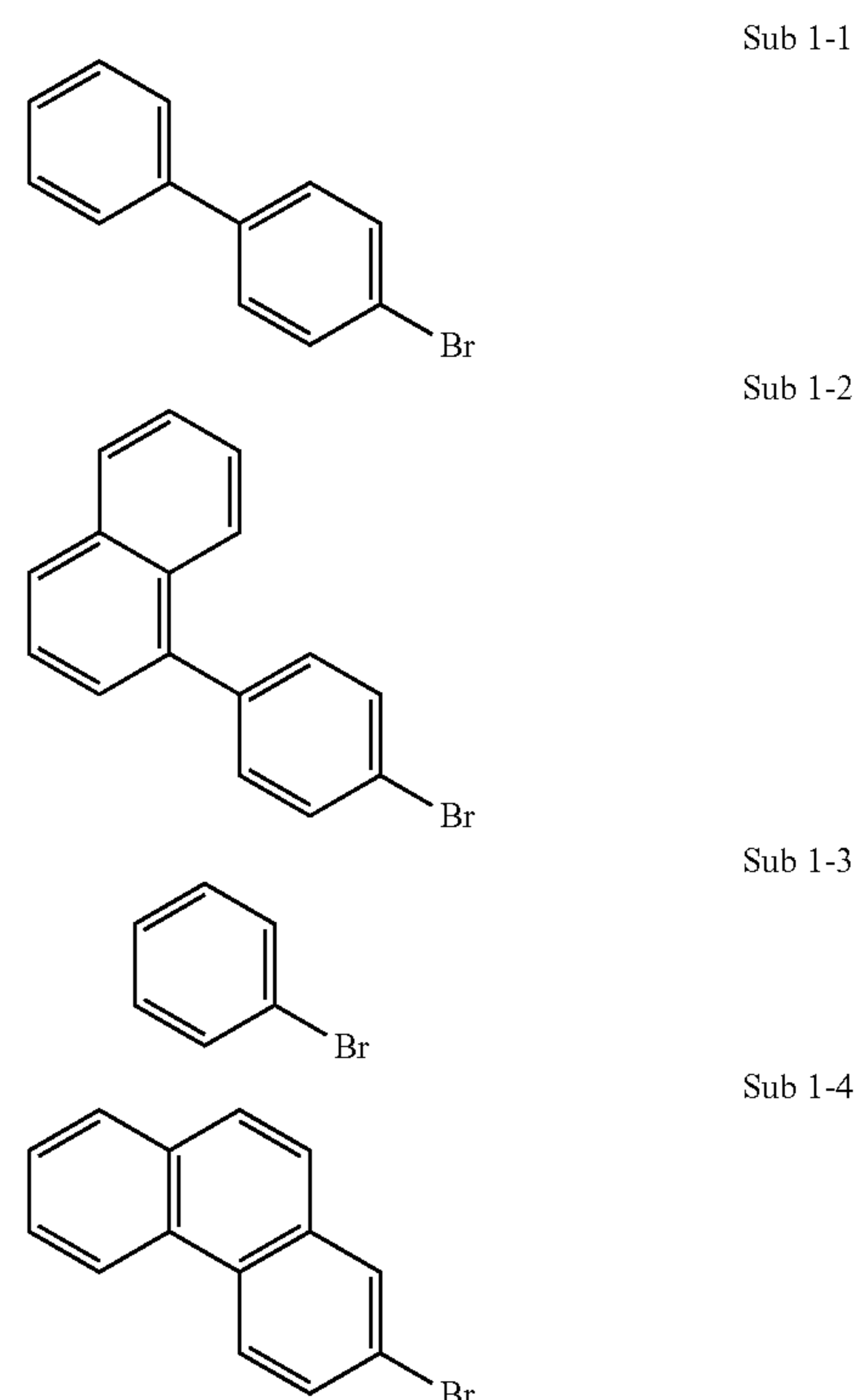
#### Synthesis Example 1

The final products 1 represented by Formula (1) of the present invention can be synthesized by reaction between Sub 1 and Sub 2 as illustrated in the following Reaction Scheme 1.



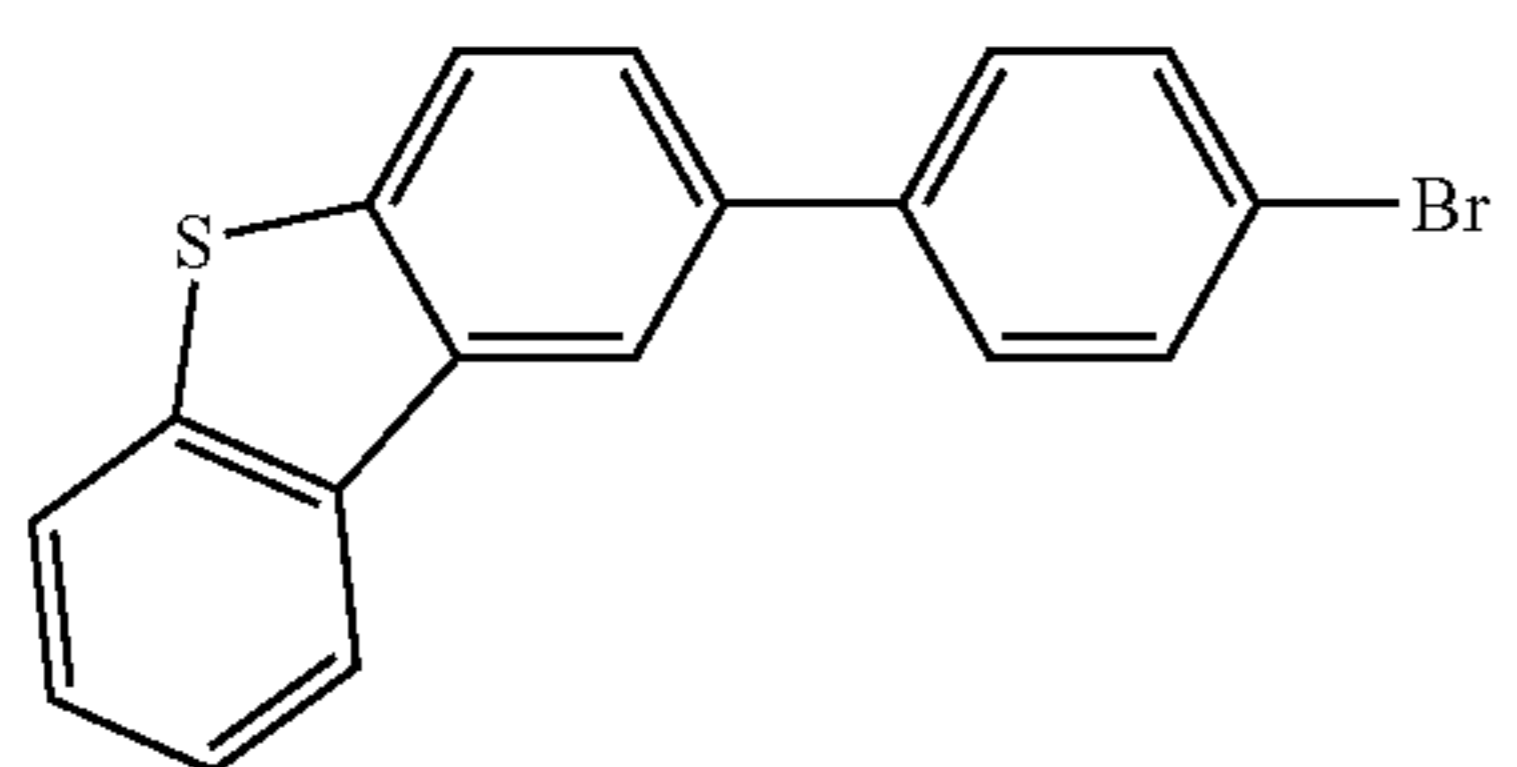
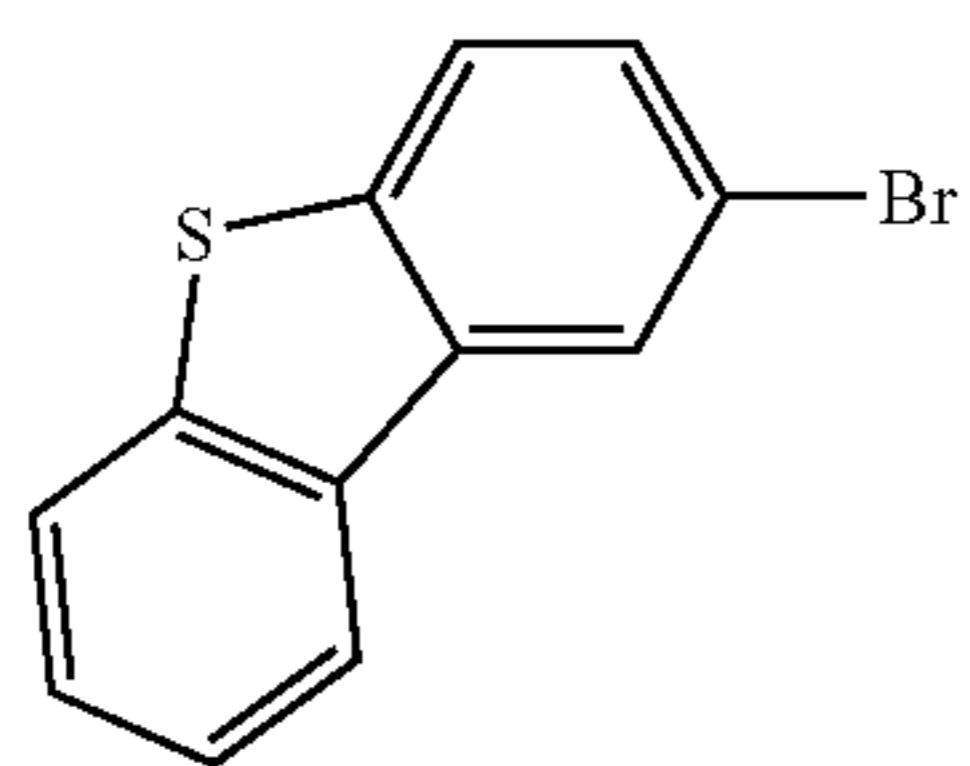
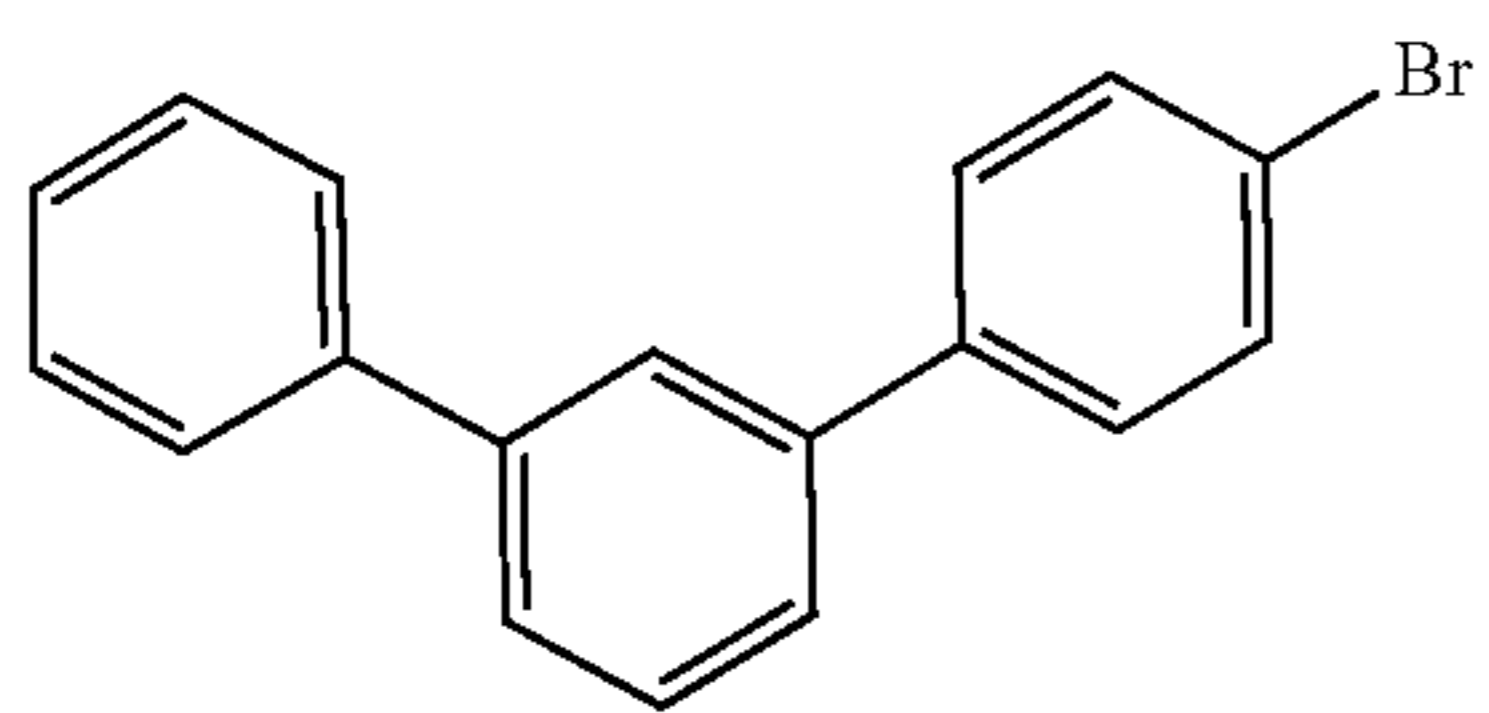
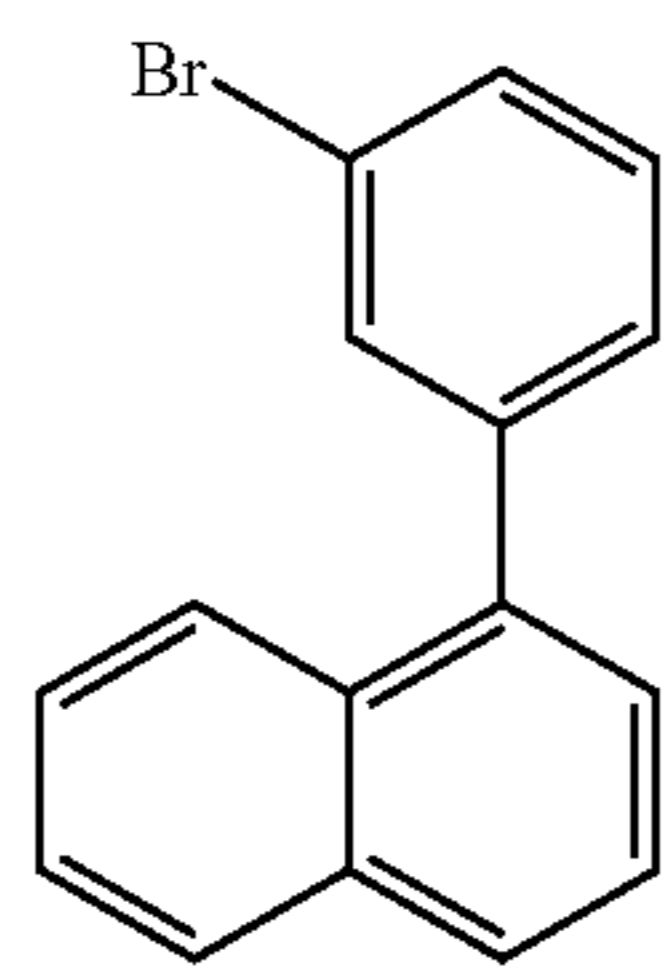
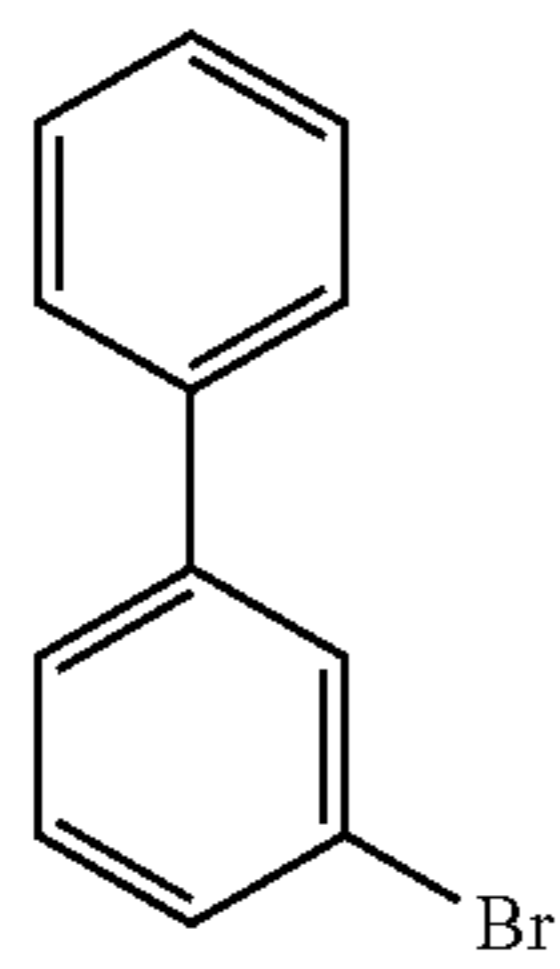
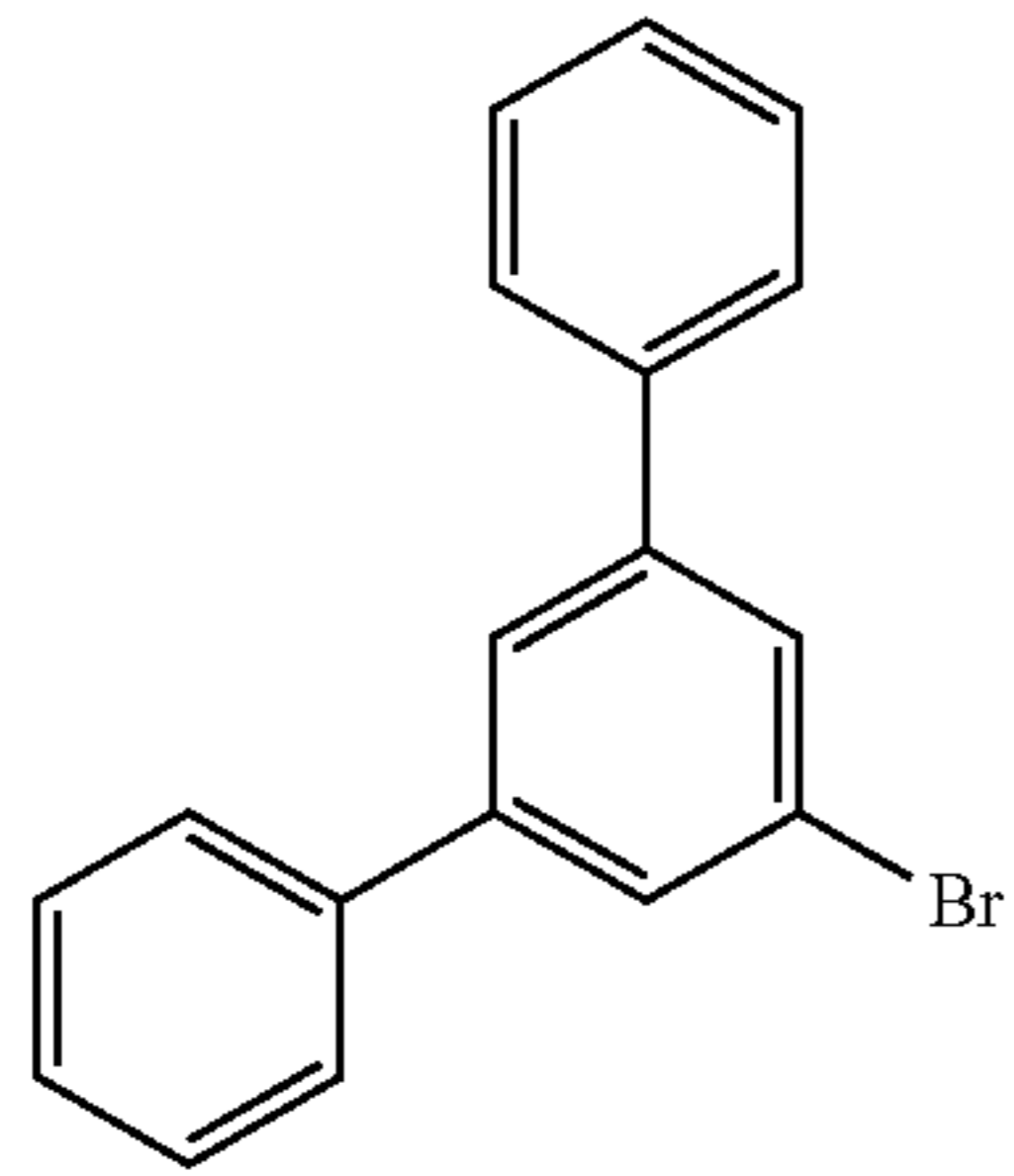
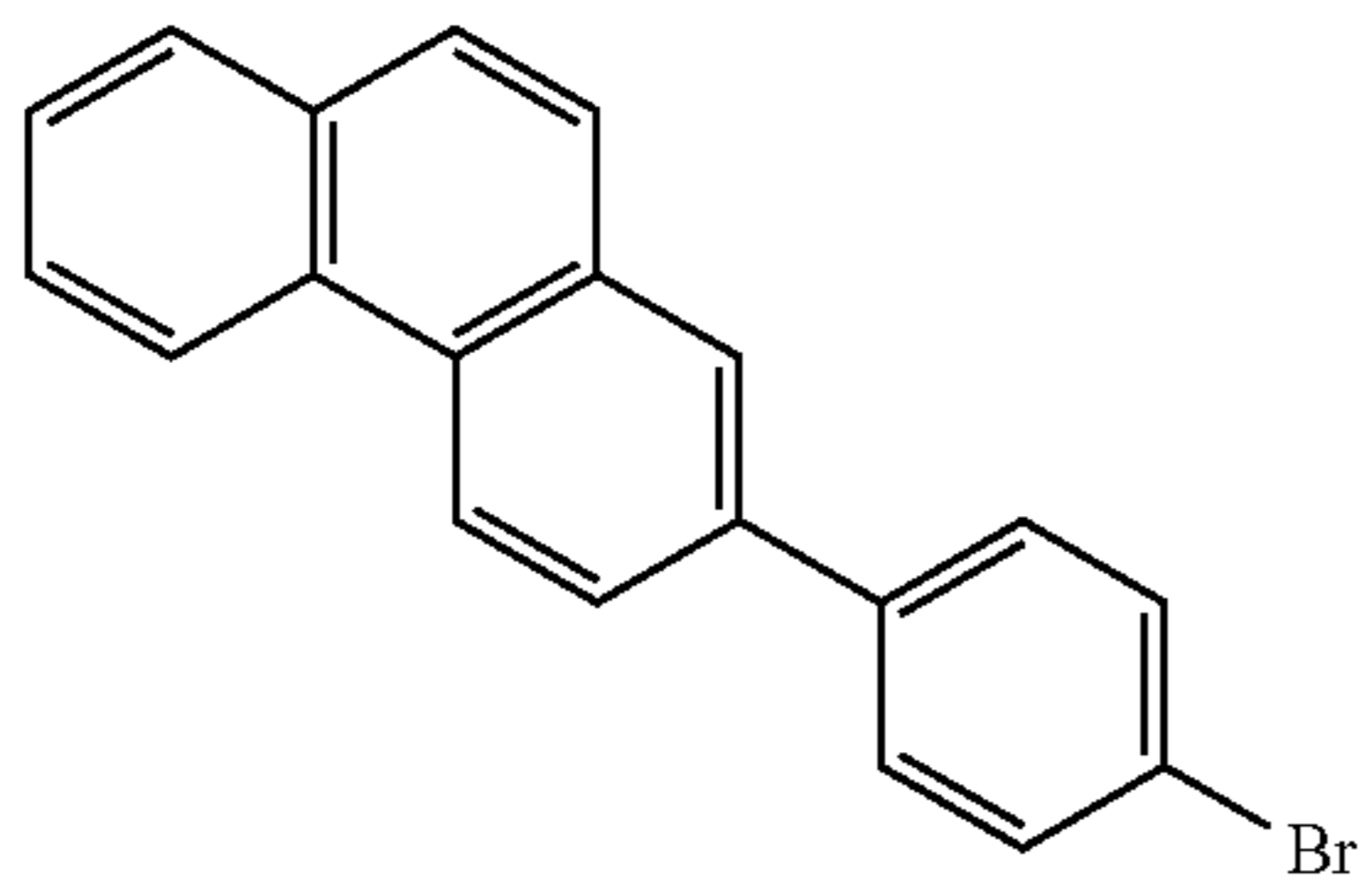
#### Examples of Sub 1

Examples of Sub 1 of reaction scheme 1 are as follows, but are not limited thereto.



**85**

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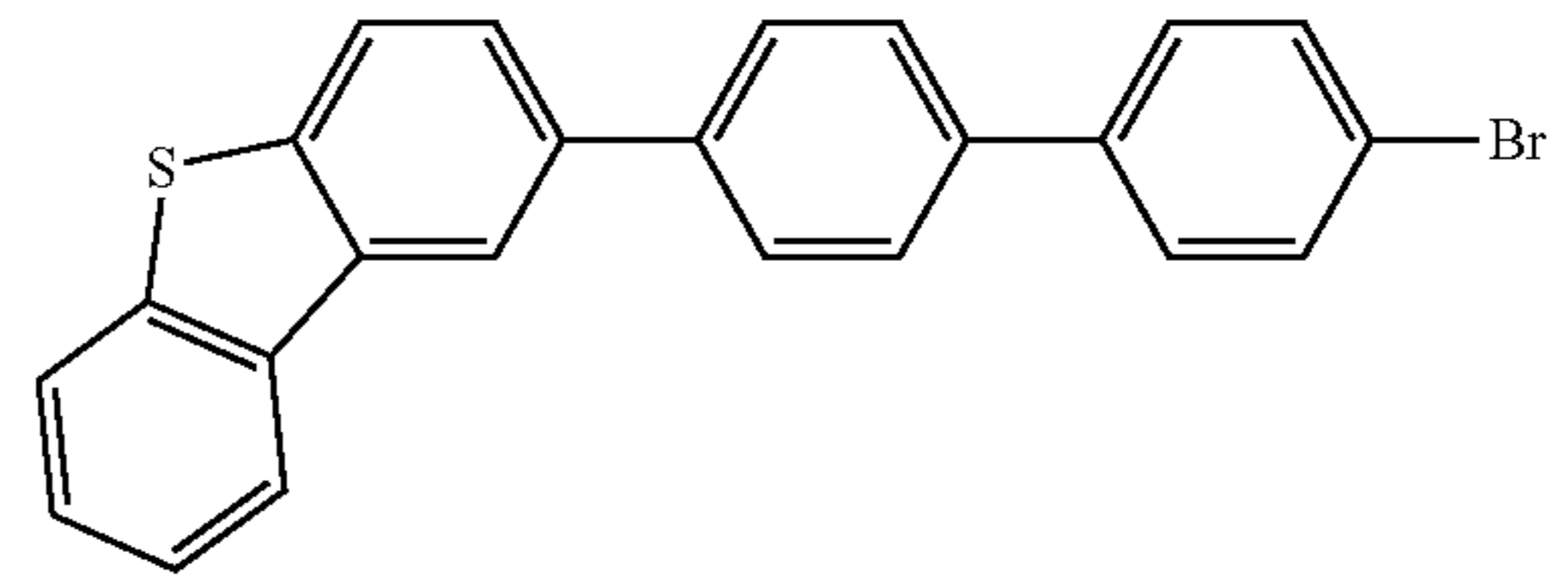


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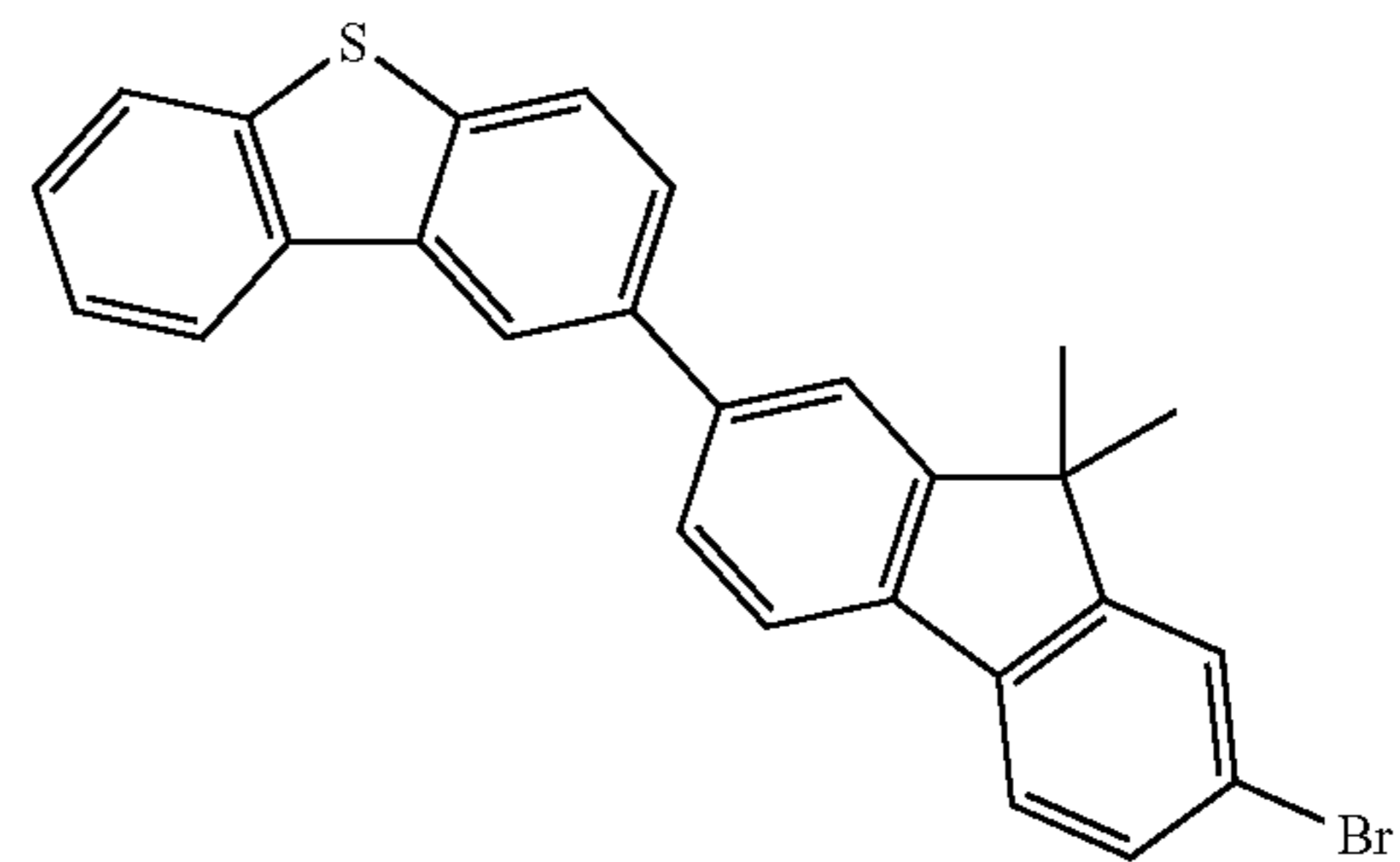
Sub 1-5

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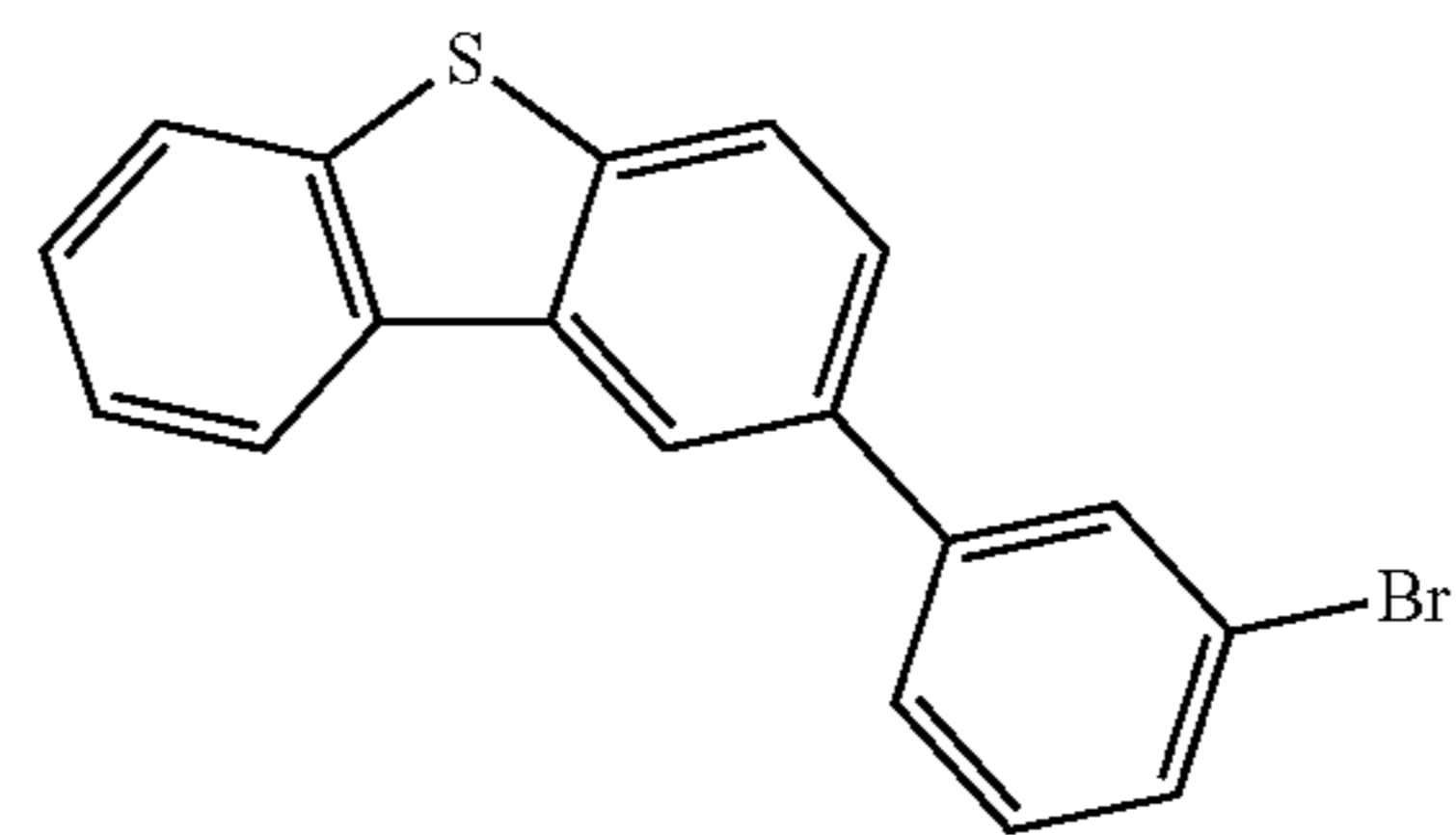
Sub 1-6

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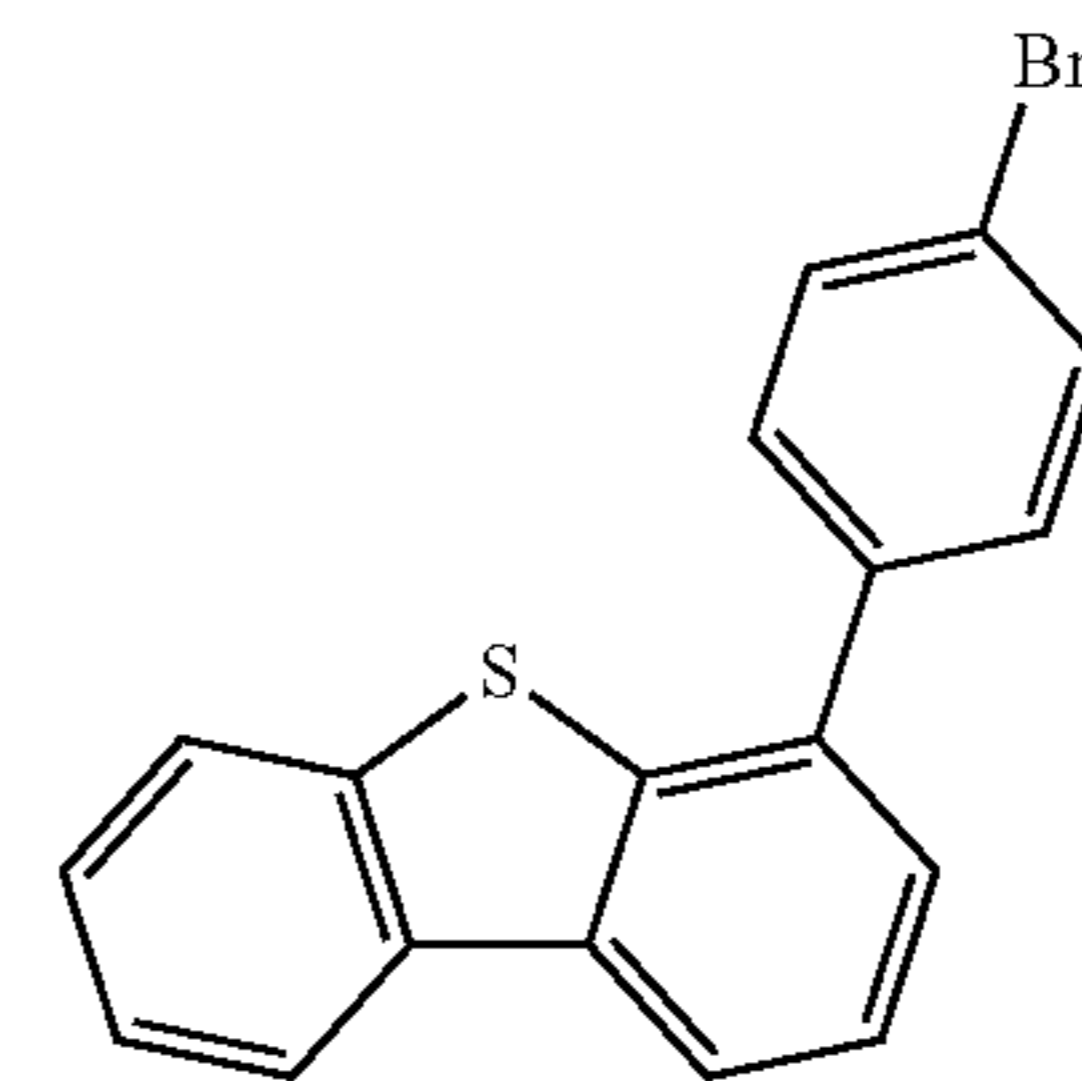
Sub 1-7

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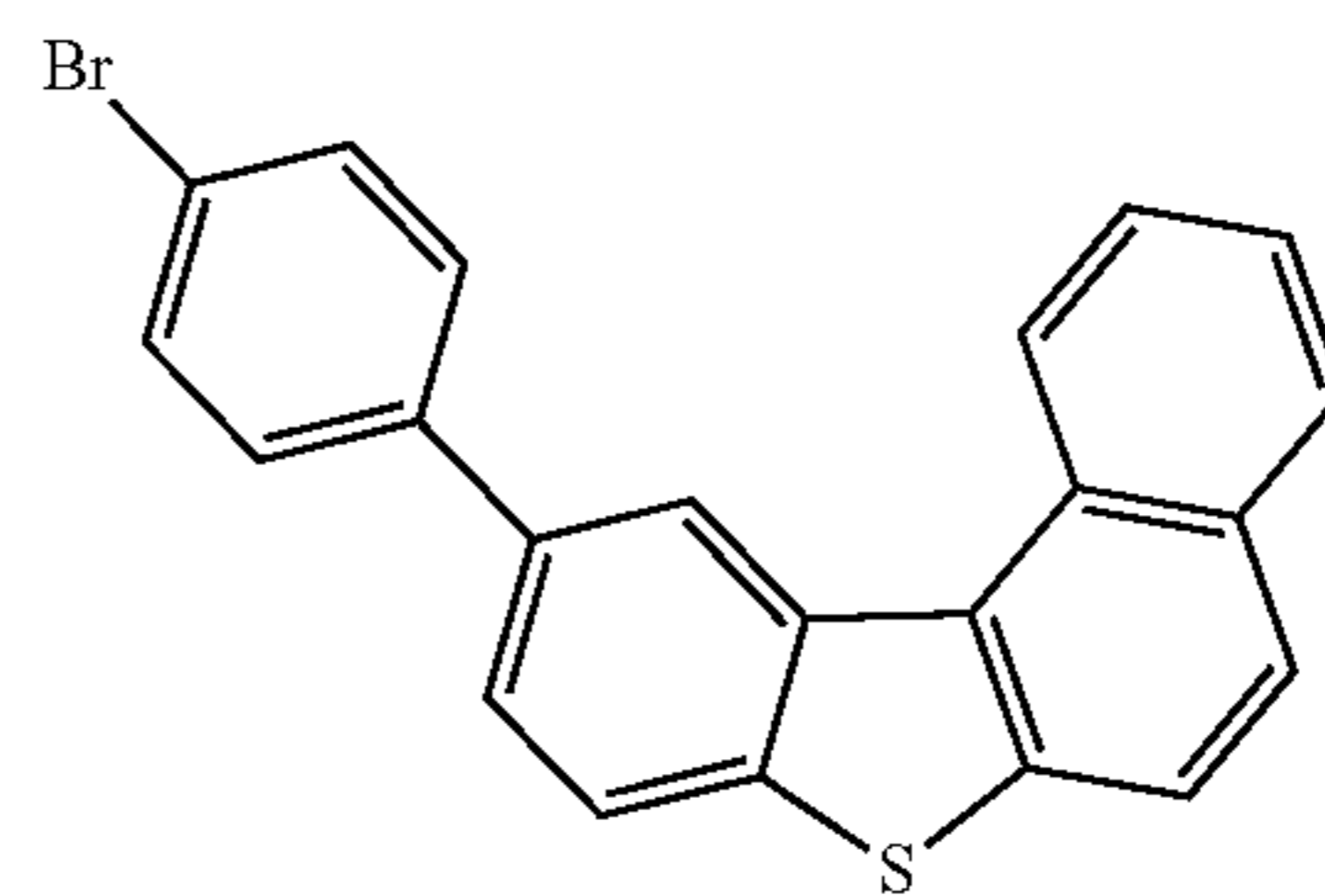
Sub 1-8

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Sub 1-9

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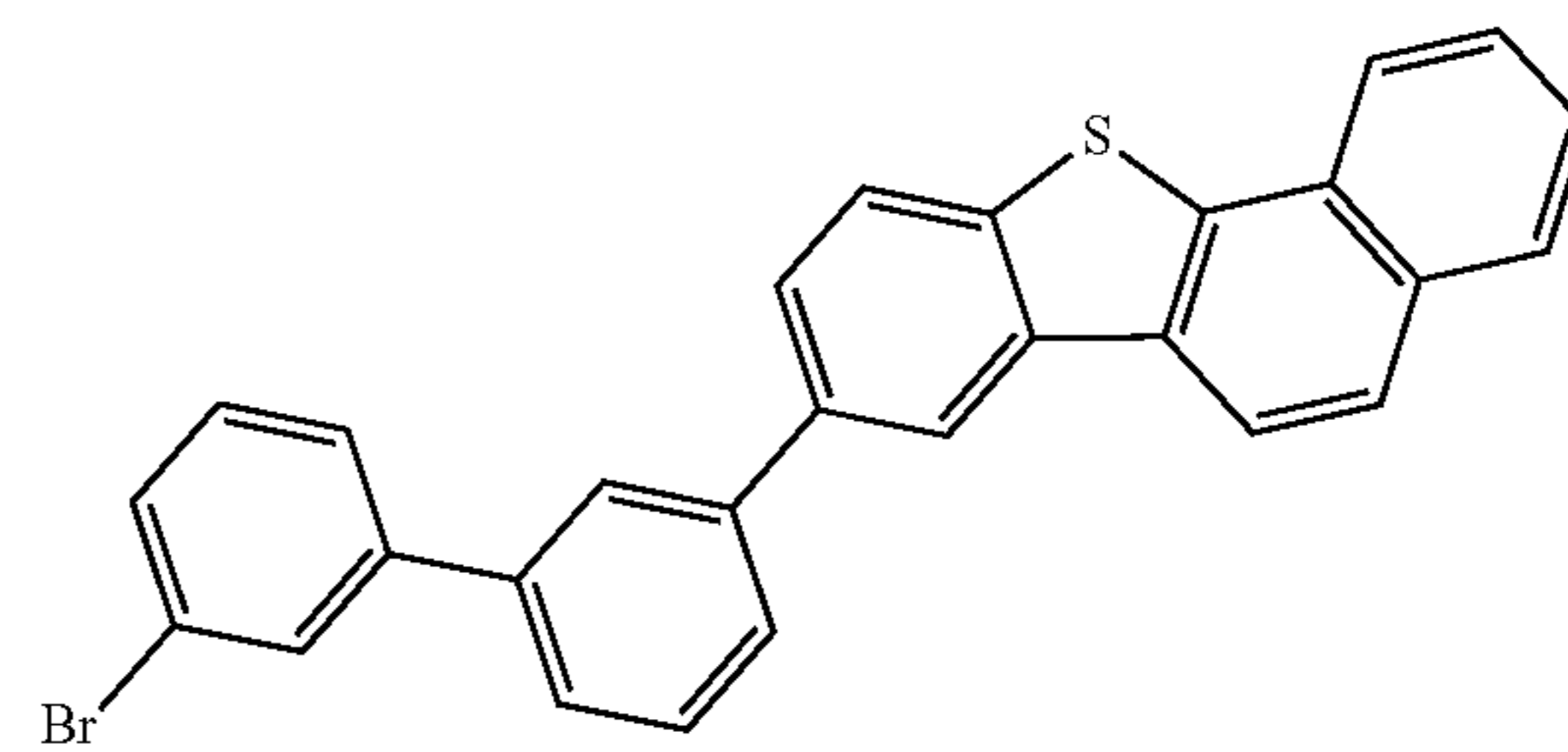


Sub 1-10

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Sub 1-11

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Sub 1-12

Sub 1-13

Sub 1-14

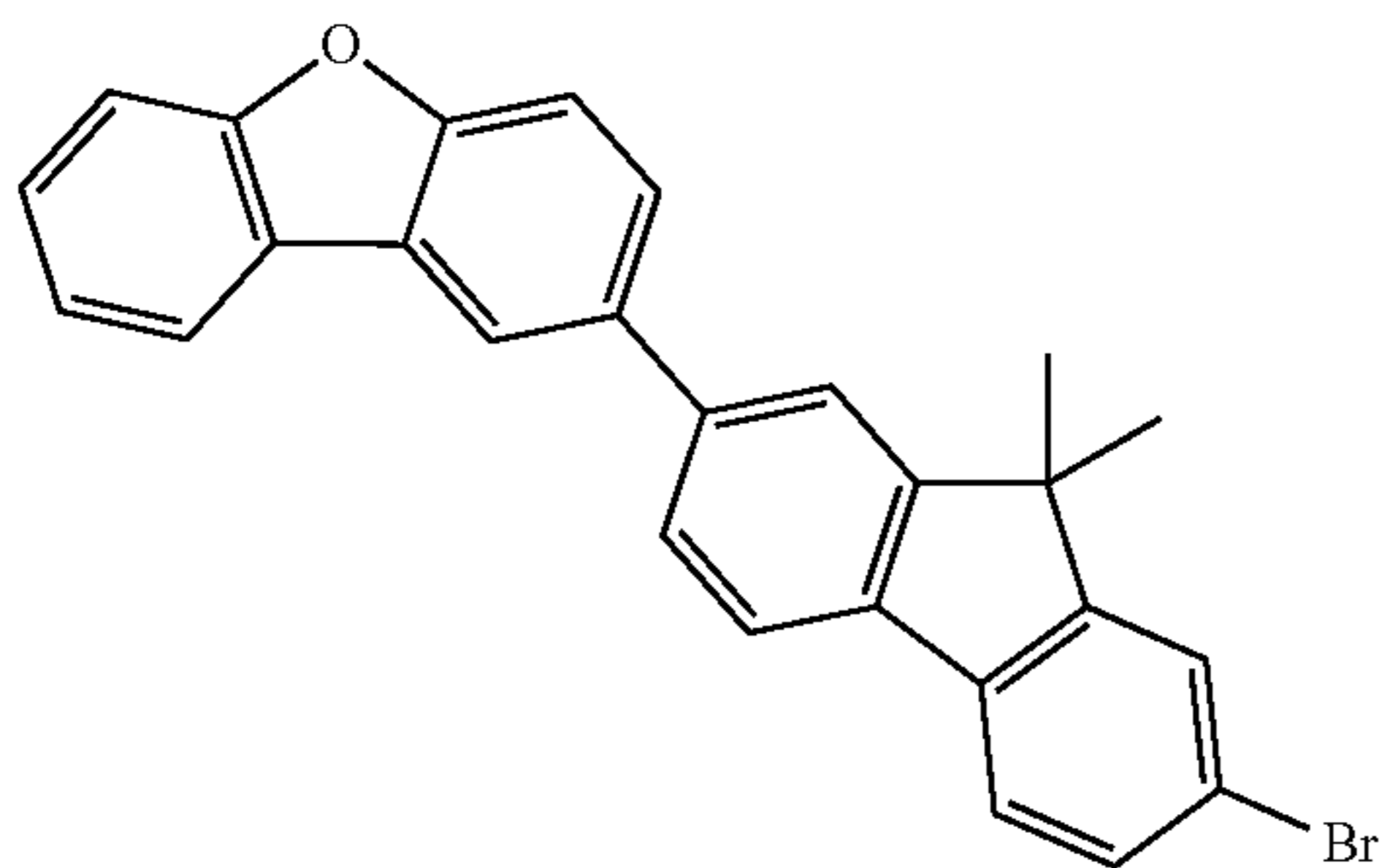
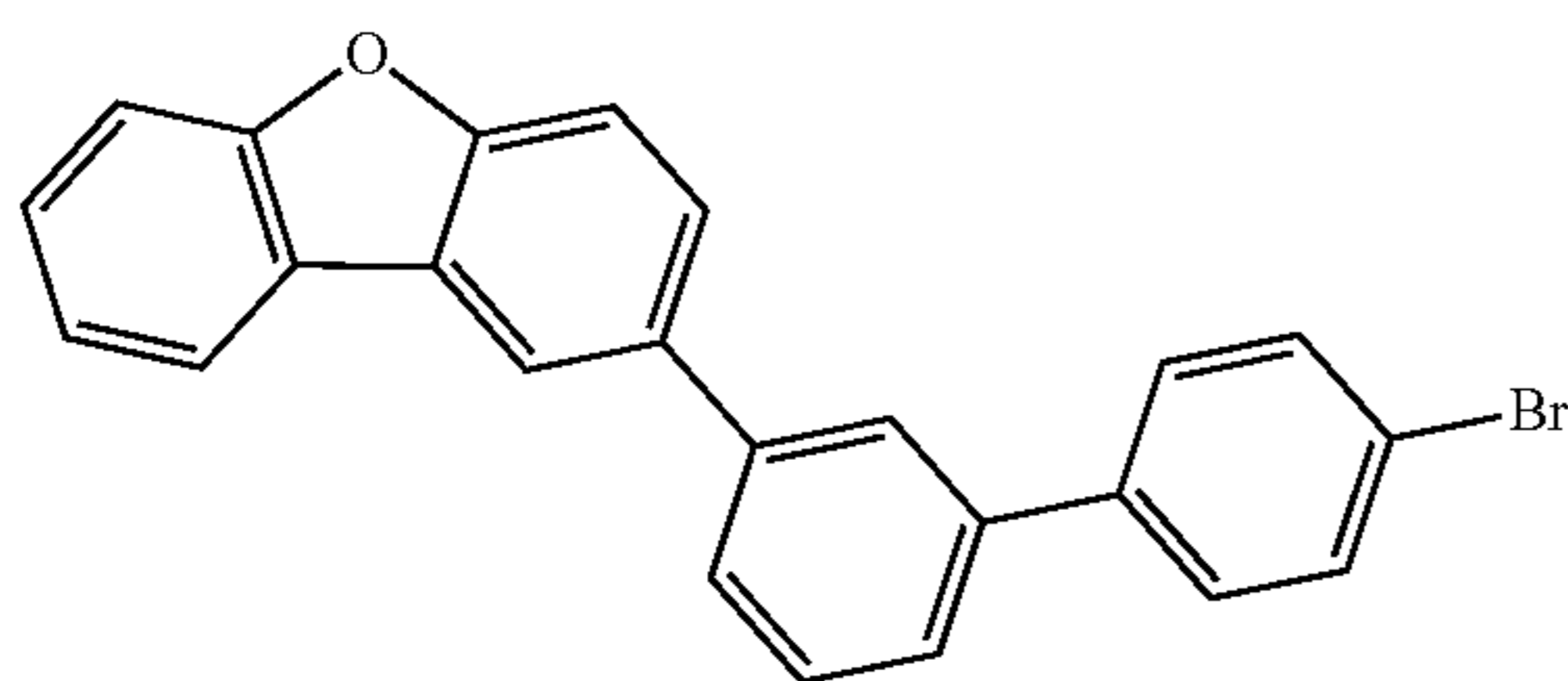
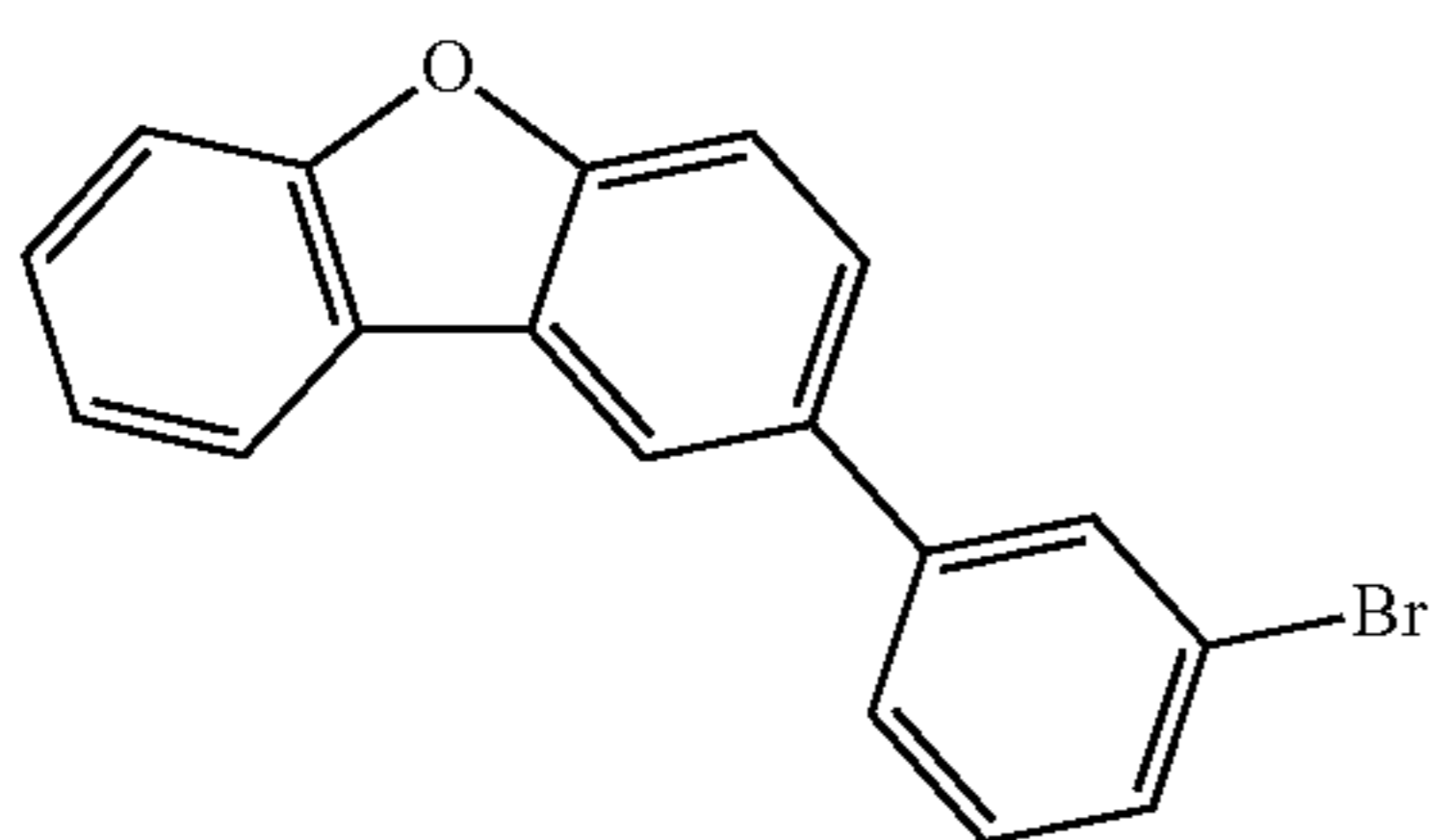
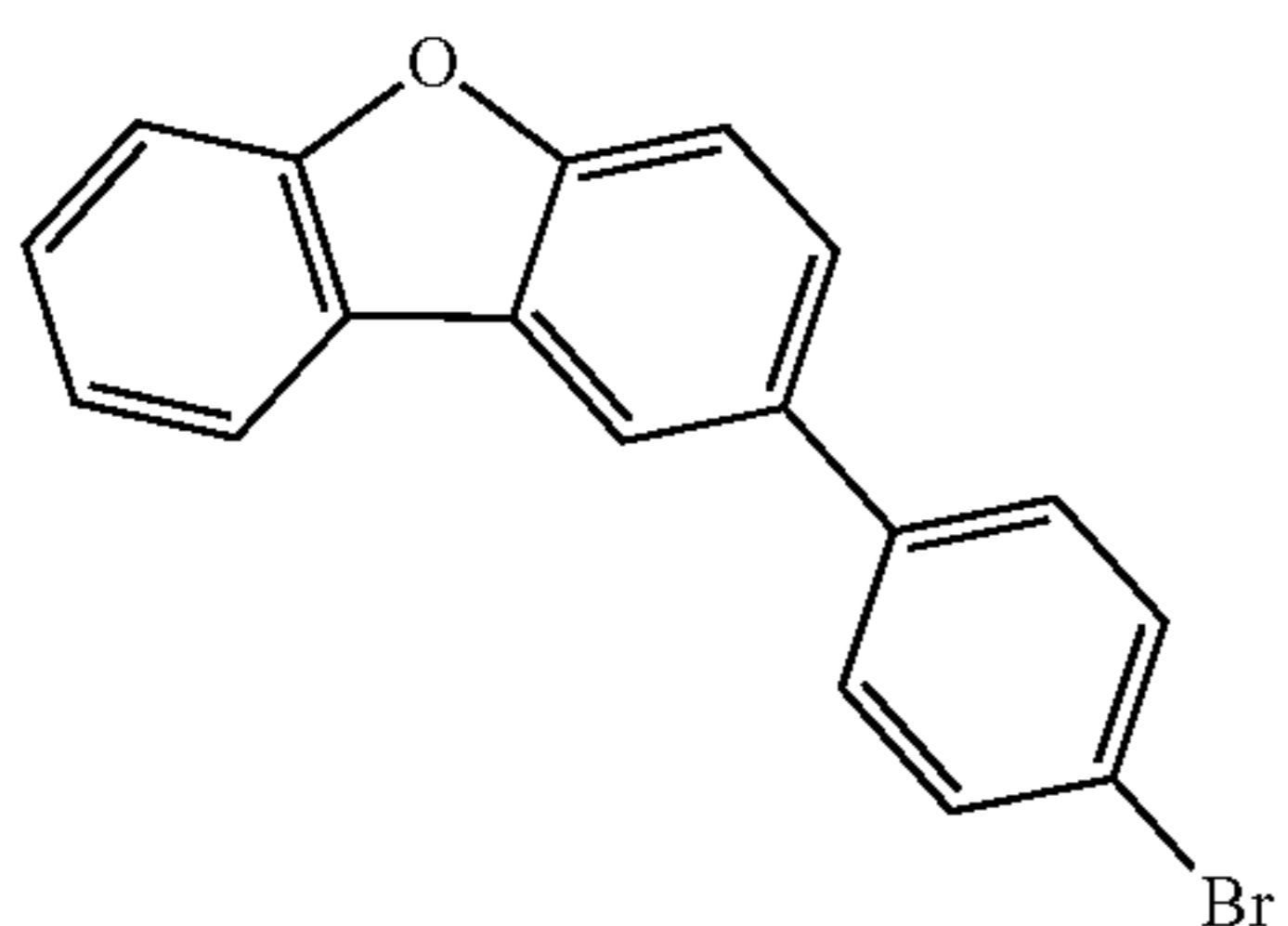
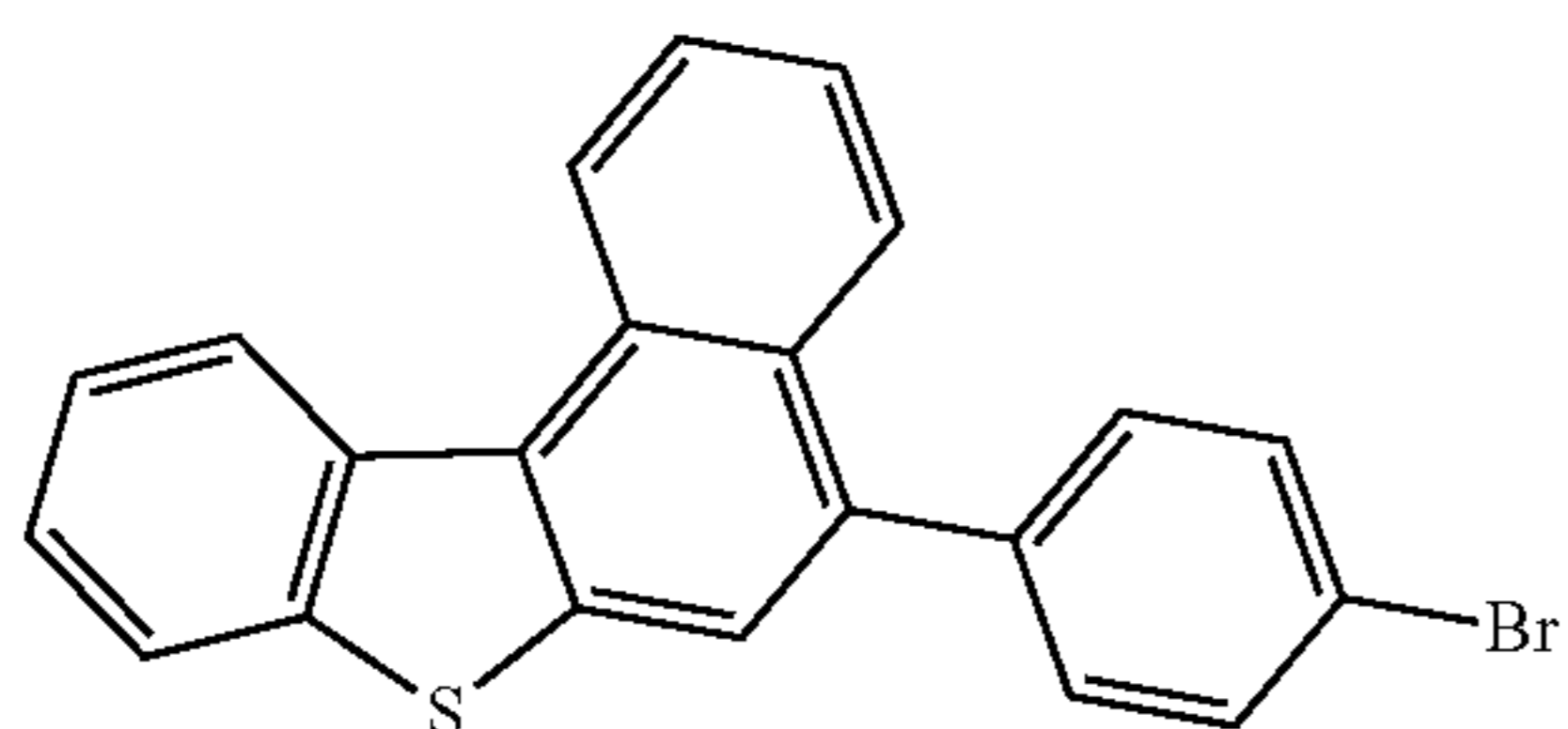
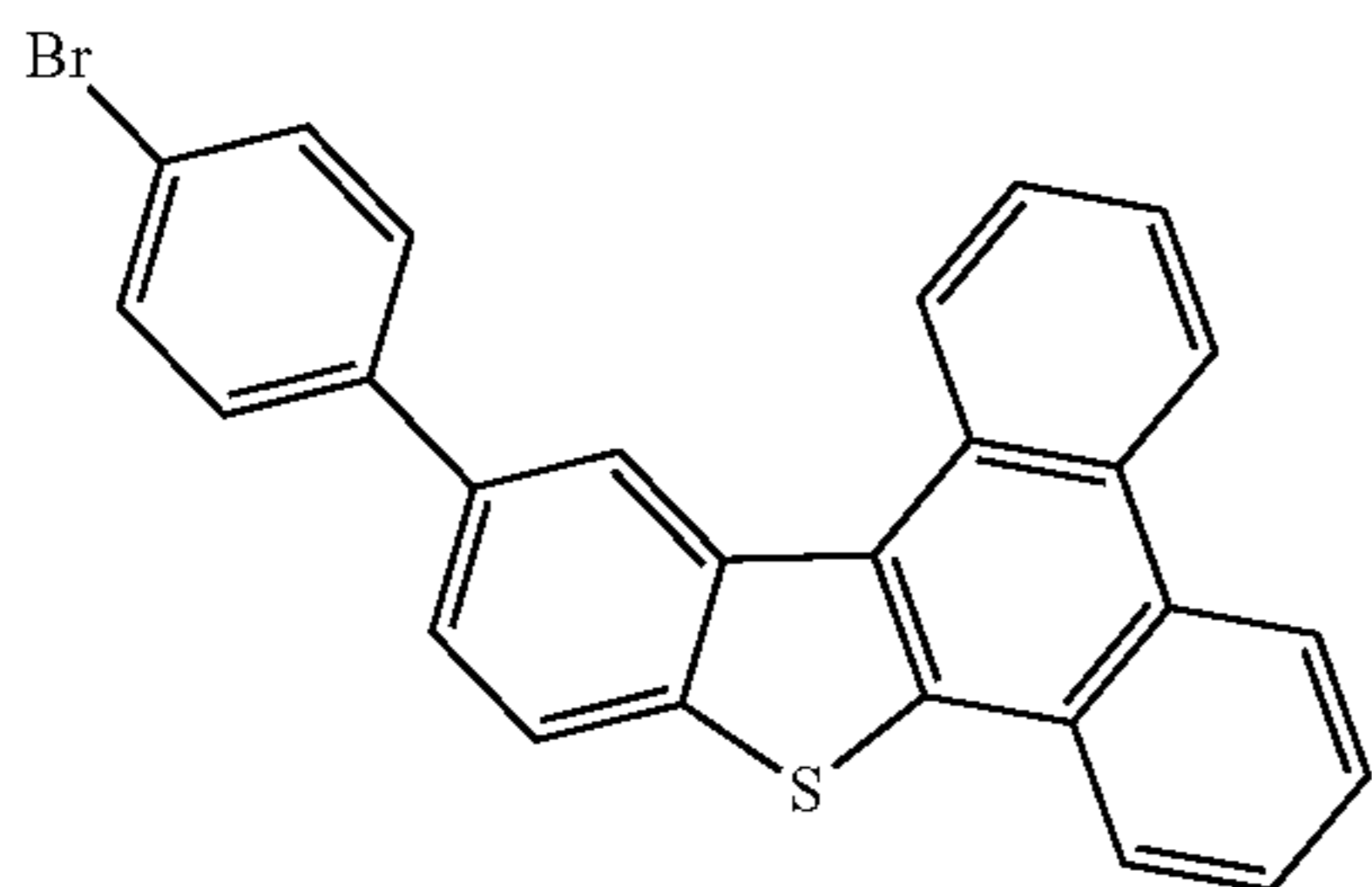
Sub 1-15

Sub 1-16

Sub 1-17

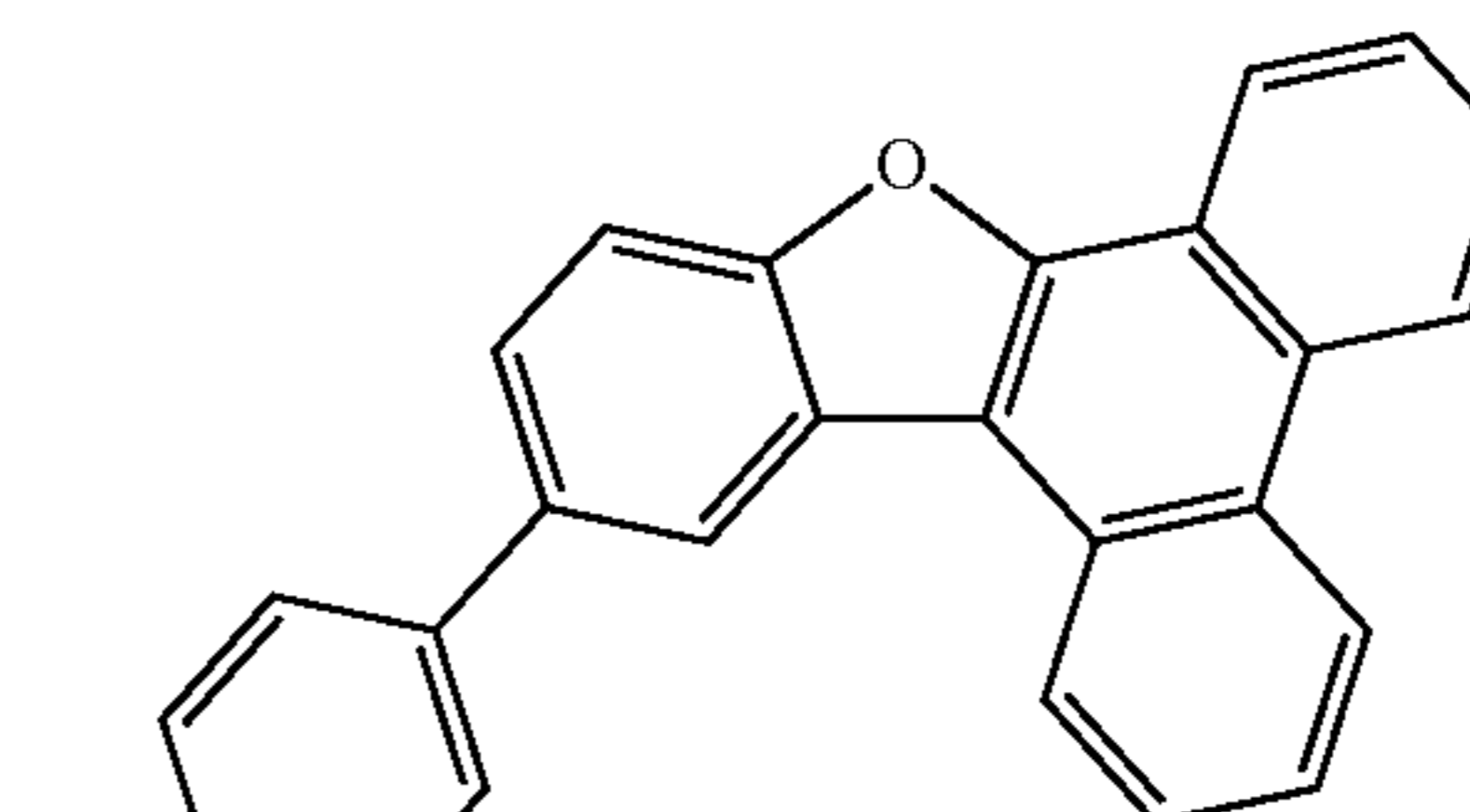
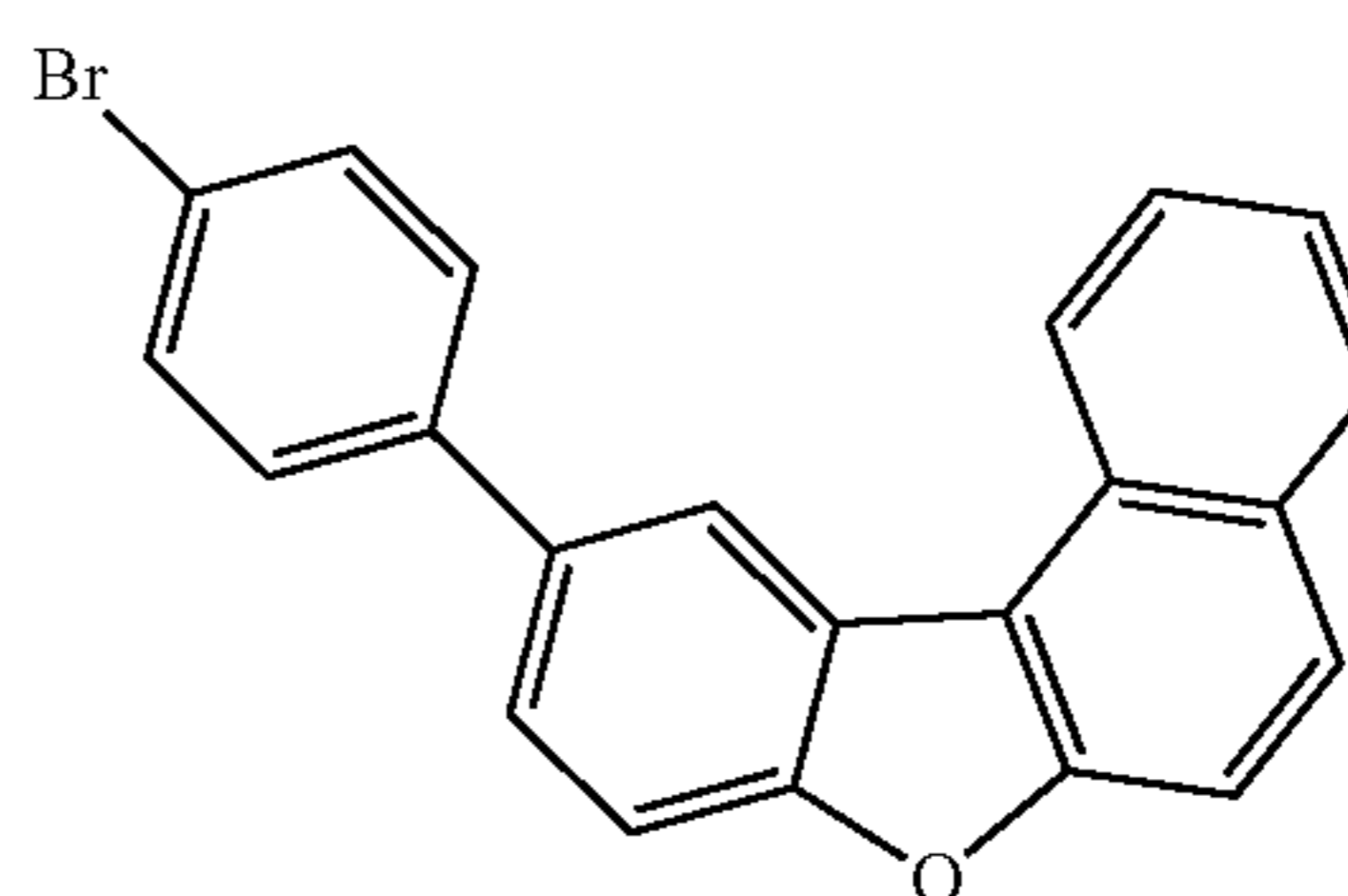
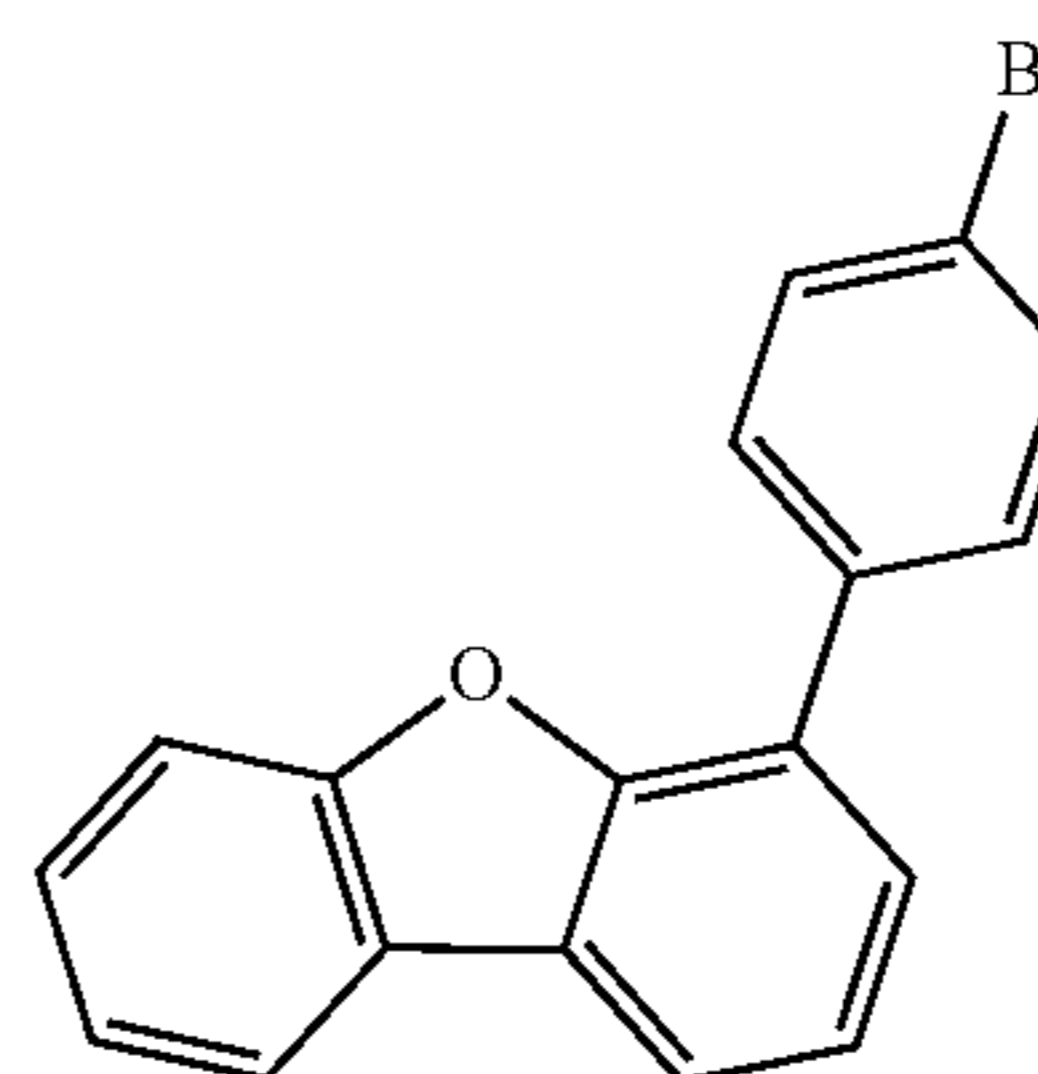
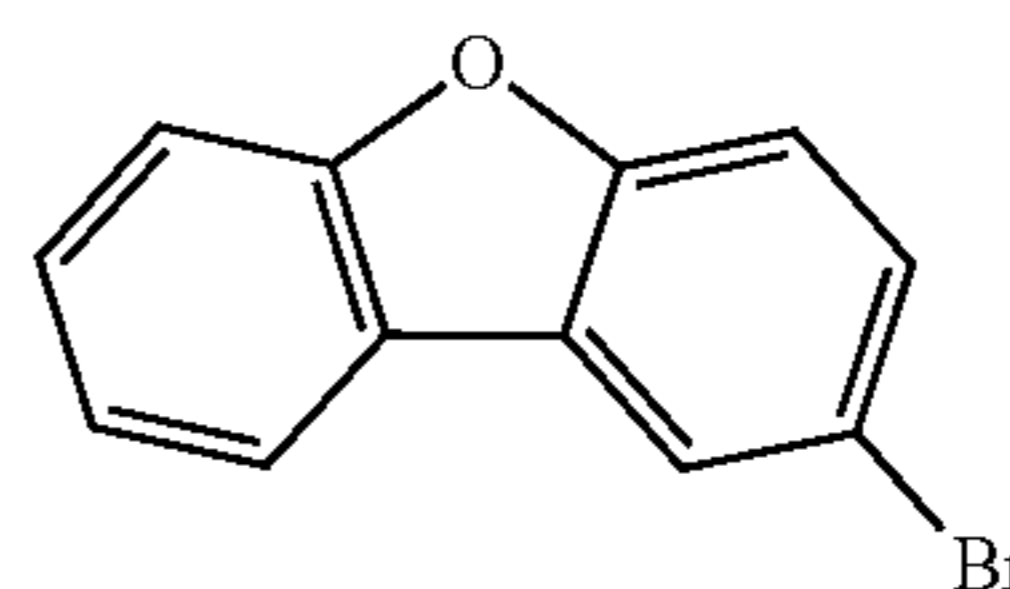
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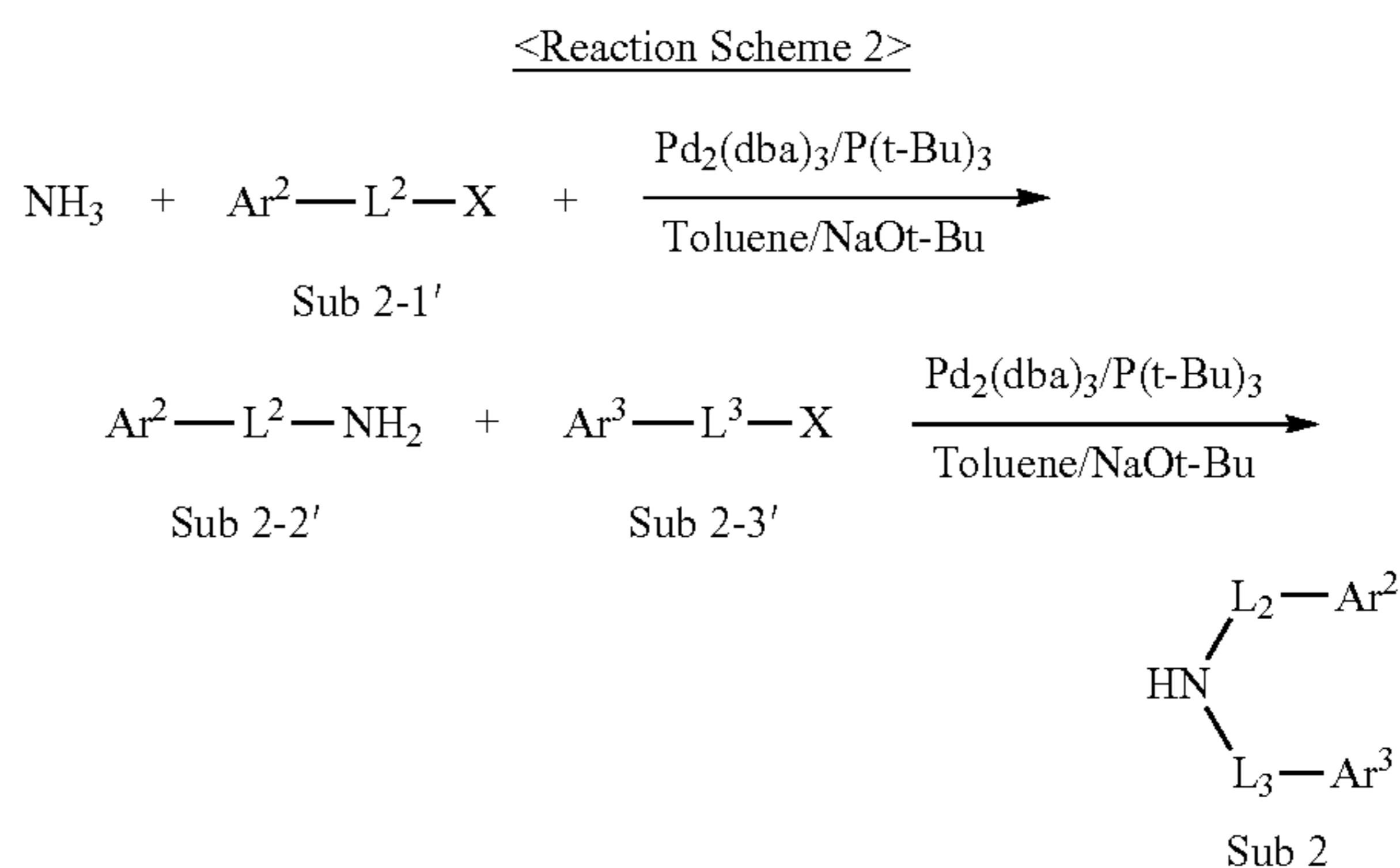
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Synthesis Examples of Sub 2

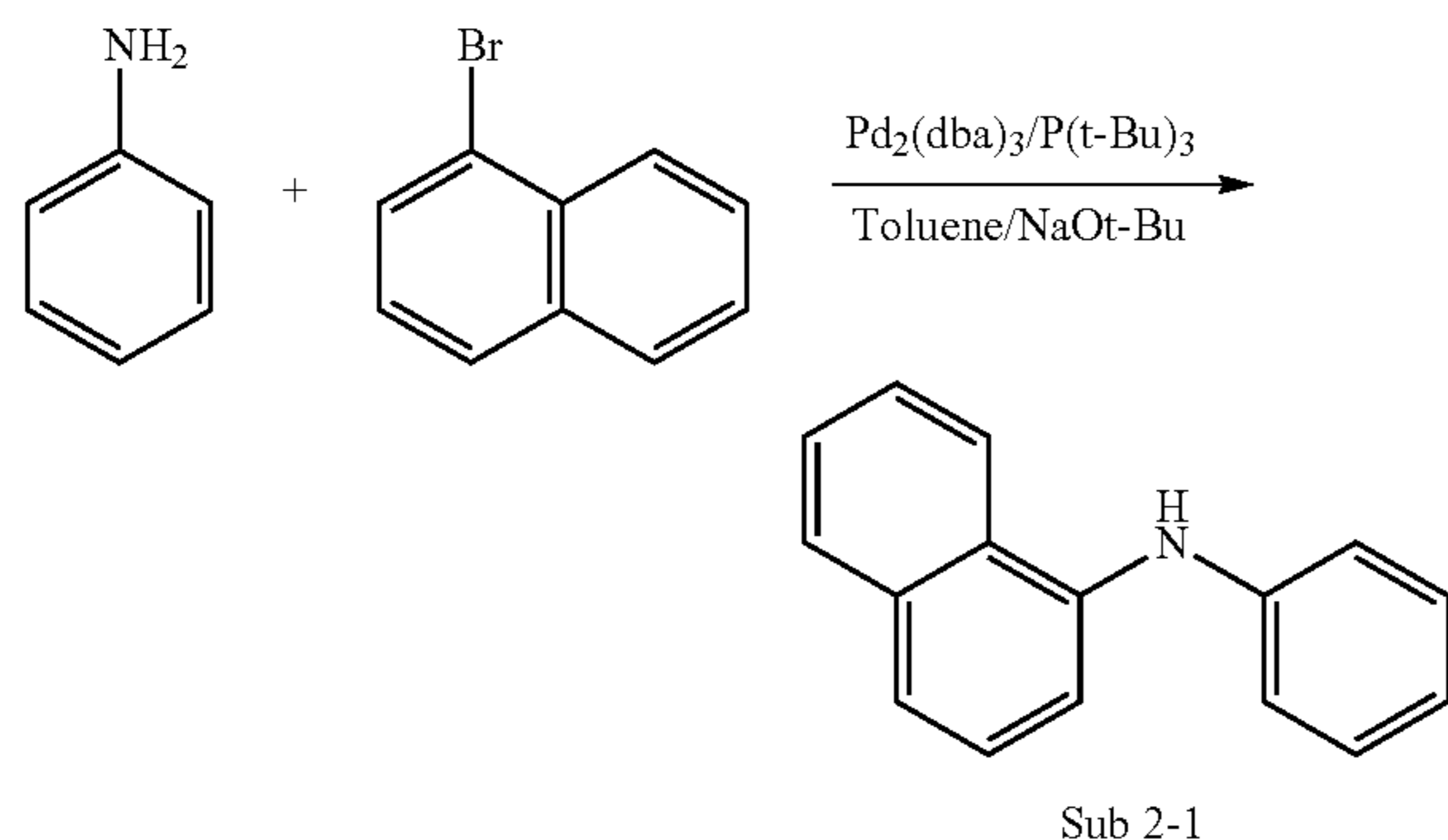
Sub 2 of reaction scheme 1 can be synthesized by the reaction path of the following reaction scheme 2, but is not limited thereto.



65 X = Br, I, Cl

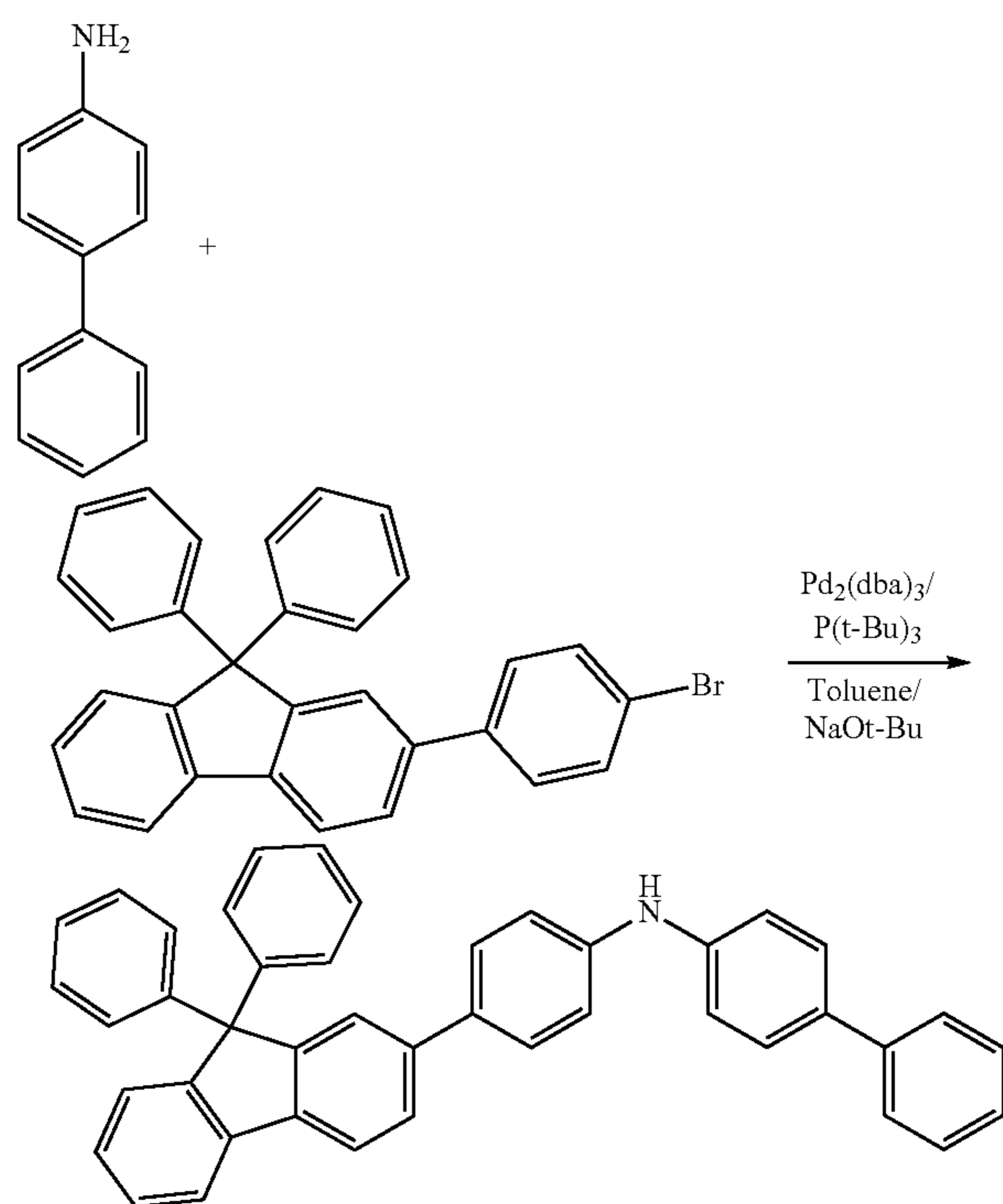
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Examples of Sub 2-1



In a round bottom flask, Aniline (15 g, 161.1 mmol), 1-bromonaphthalene (36.7 g, 177.2 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (7.37 g, 8.05 mmol), P(t-Bu)<sub>3</sub> (3.26 g, 16.1 mmol), NaOt-Bu (51.08 g, 531.5 mmol), toluene (1690 mL) were added, and stirred at 100° C. After the reaction was completed, the reaction mixture was extracted with CH<sub>2</sub>Cl<sub>2</sub> and water. The organic layer was dried over MgSO<sub>4</sub> and concentrated. The resulting compound was separated by silicagel column chromatography and recrystallized to obtain 25.4 g of Sub 2-1. (Yield: 72%)

Examples of Sub 2-26

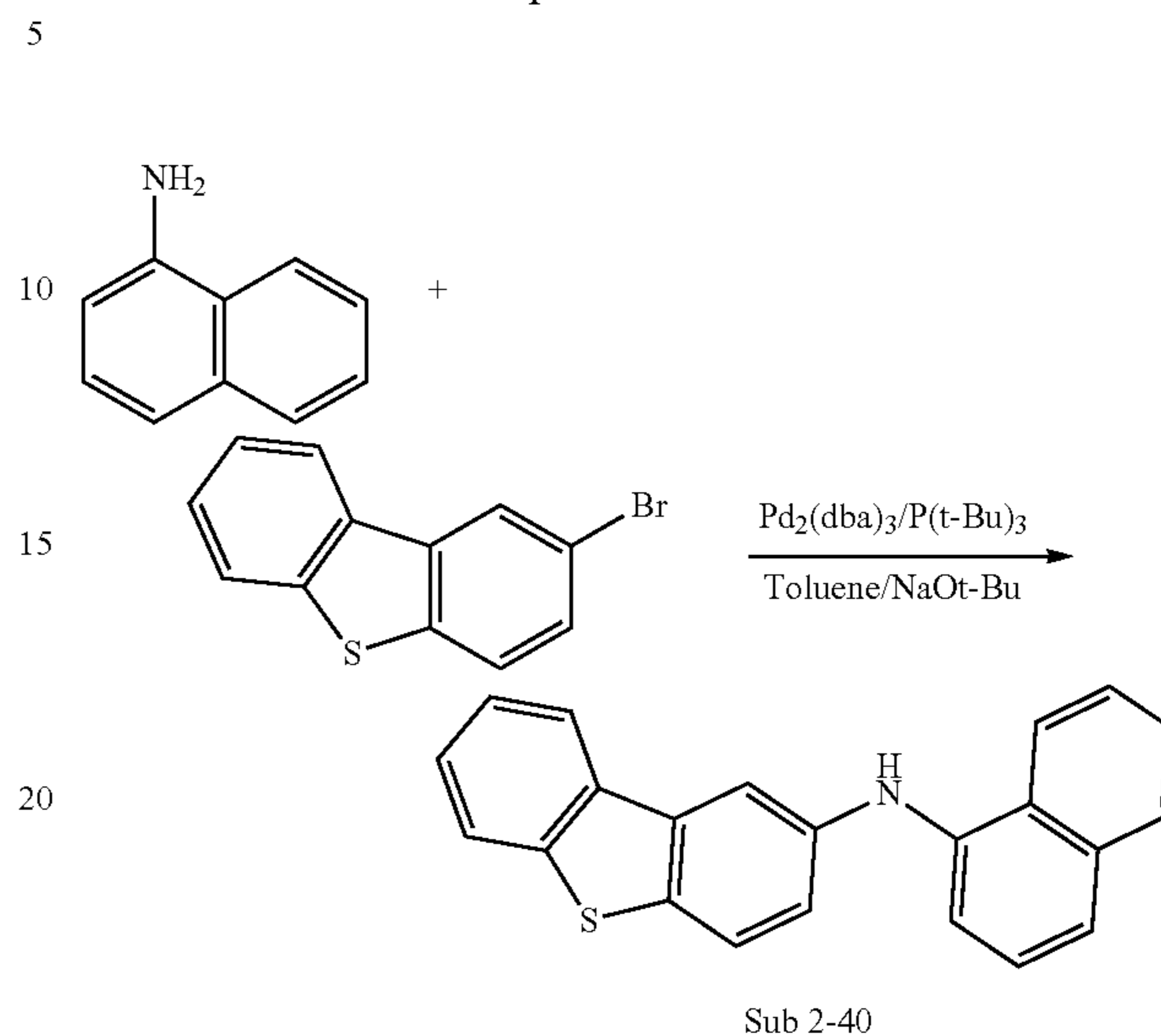


In a round bottom flask, [1,1'-biphenyl]-4-amine (15 g, 88.6 mmol), 2-(4-bromophenyl)-9,9-diphenyl-9H-fluorene (46.2 g, 97.5 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (4.06 g, 4.43 mmol), P(t-Bu)<sub>3</sub> (1.8 g, 8.86 mmol), NaOt-Bu (28.1 g, 292.5 mmol),

90

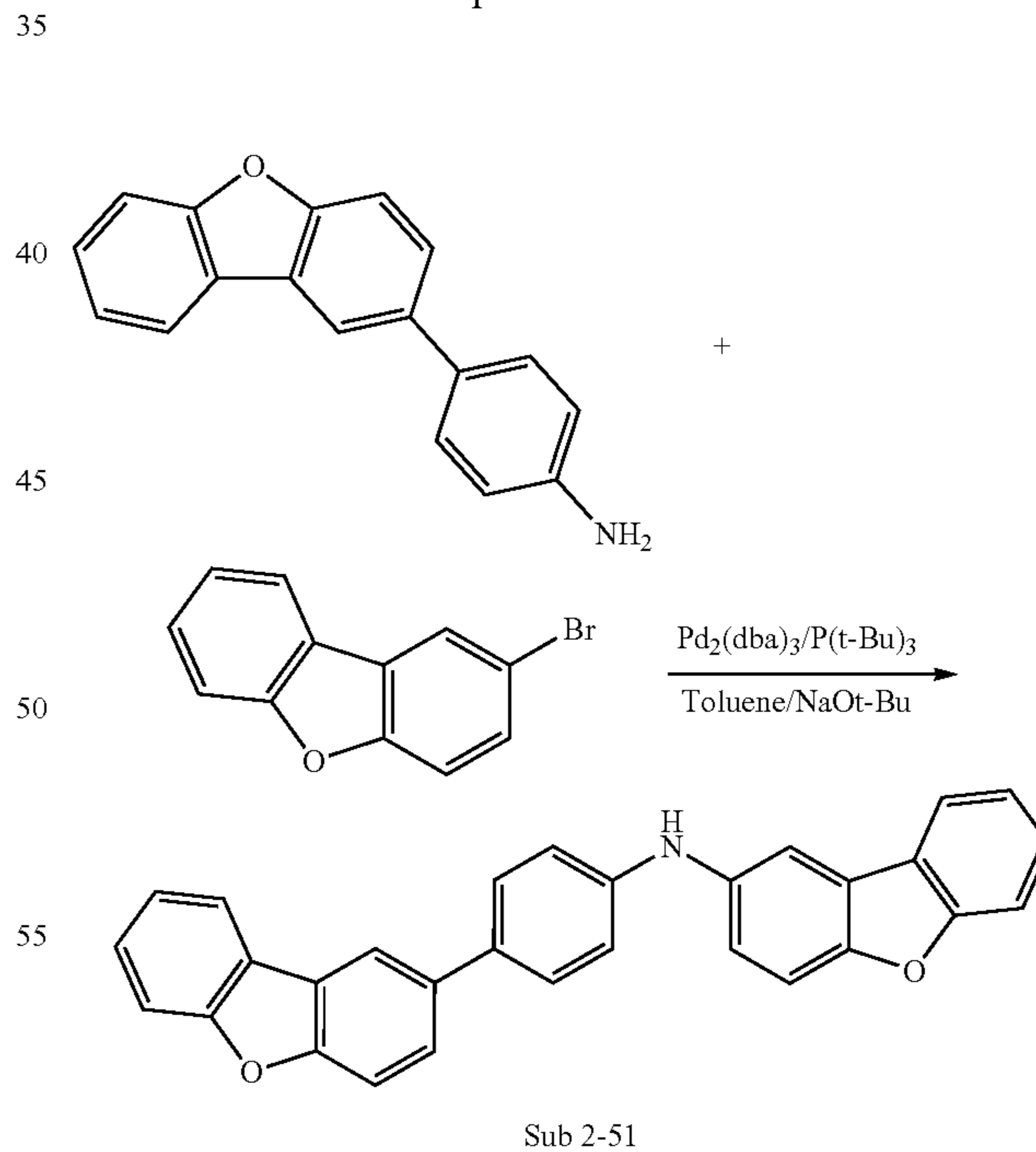
toluene (931 mL) were tested in the same manner as Sub 2-1 to obtain 34.9 g of Sub 2-26. (Yield: 70%)

Examples of Sub 2-40



In a round bottom flask, naphthalen-1-amine (15 g, 104.8 mmol), 2-bromodibenzo[b,d]thiophene (30.3 g, 115.2 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (4.8 g, 5.24 mmol), P(t-Bu)<sub>3</sub> (2.12 g, 10.48 mmol), NaOt-Bu (33.22 g, 345.7 mmol), toluene (1100 mL) were tested in the same manner as Sub 2-1 to obtain 24.9 g of Sub 2-40. (Yield: 73%)

Examples of Sub 2-51

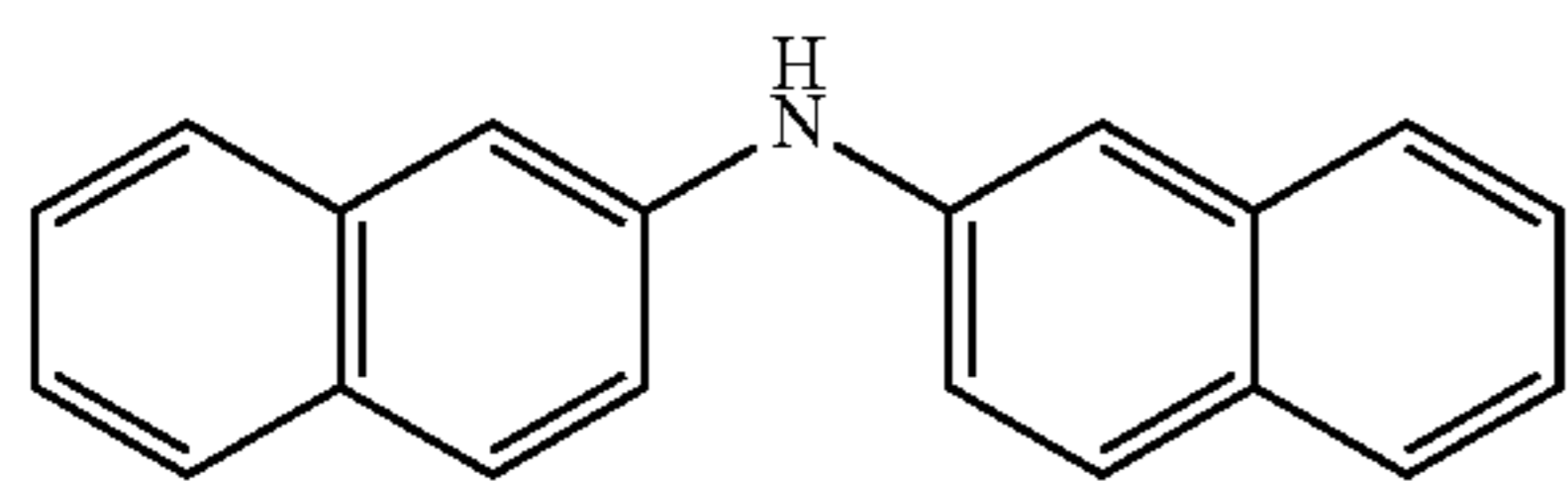
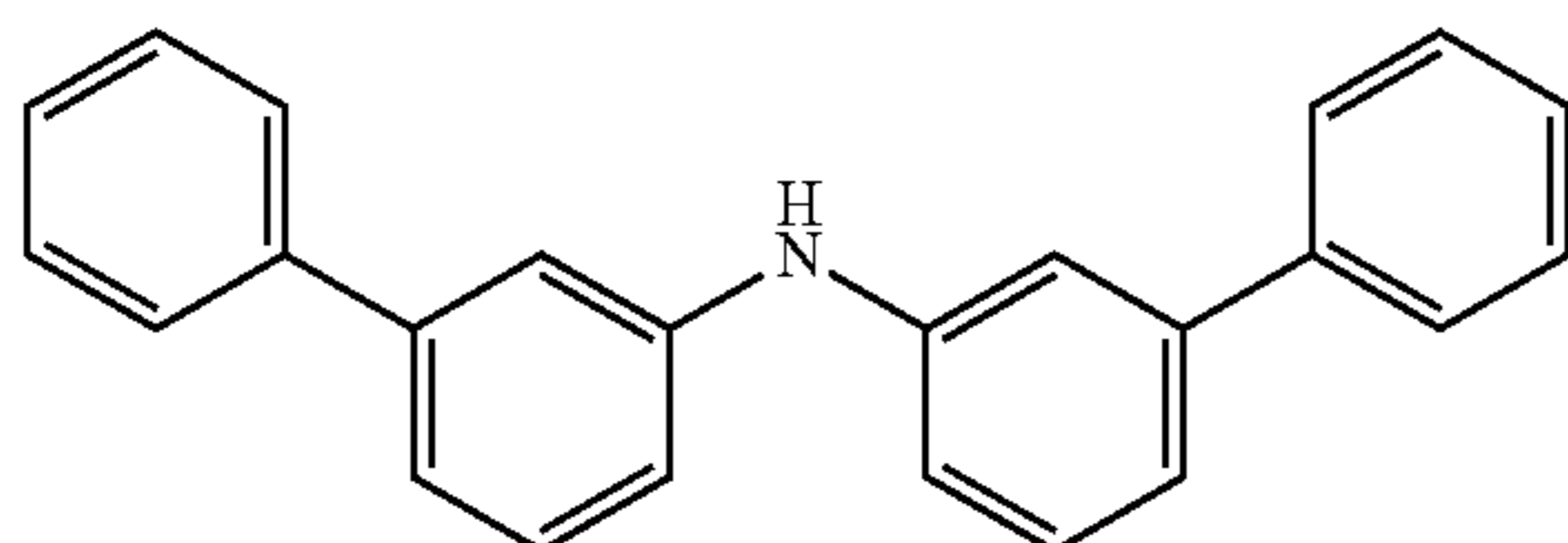
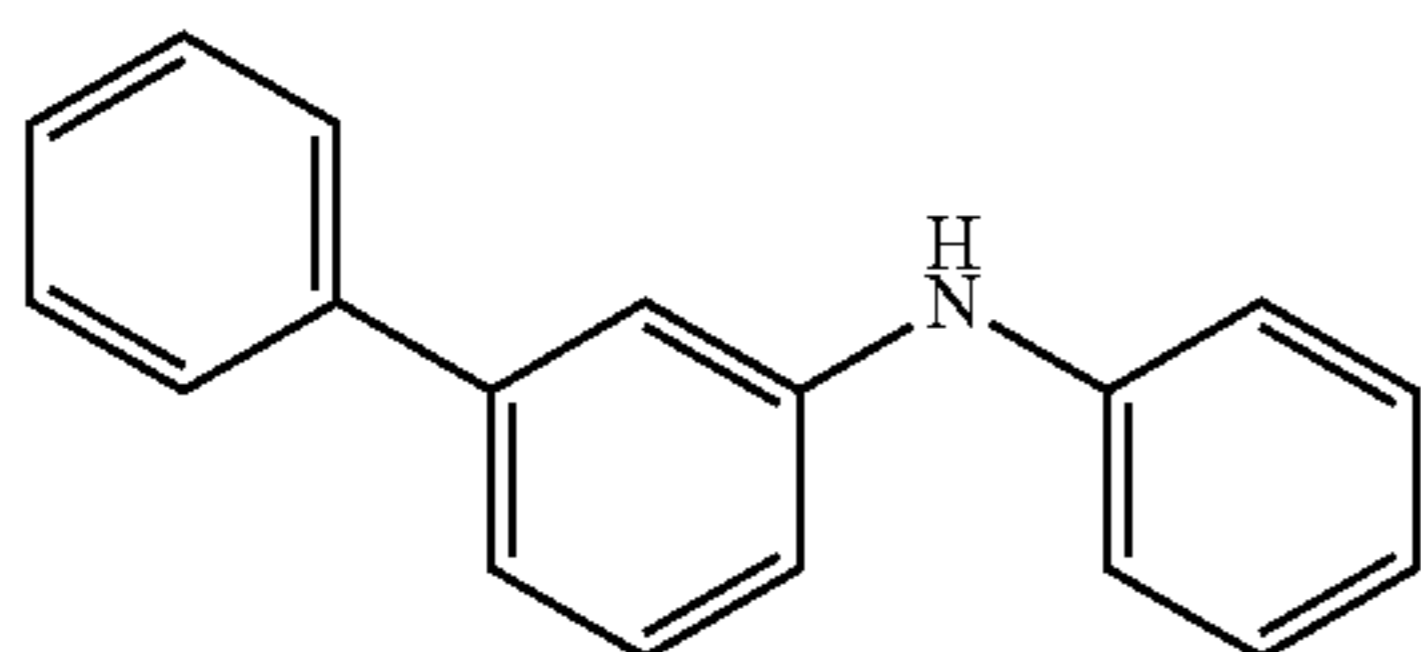
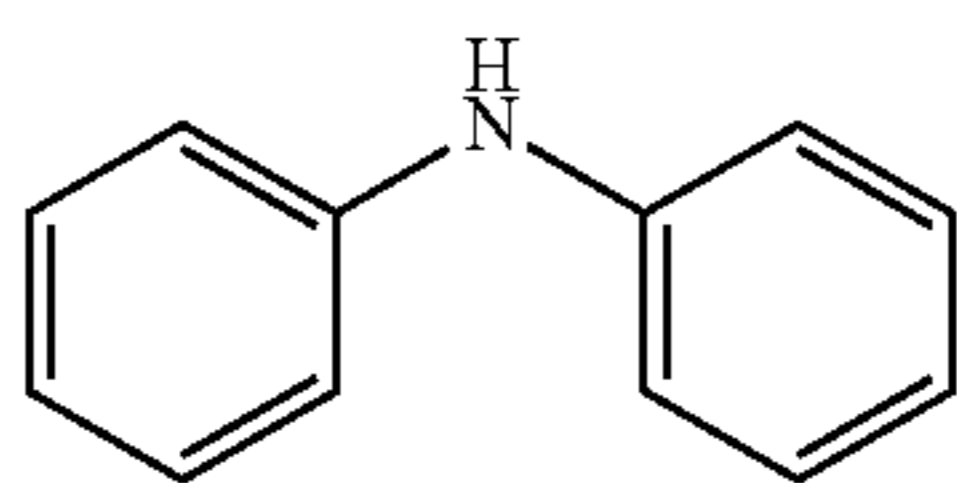
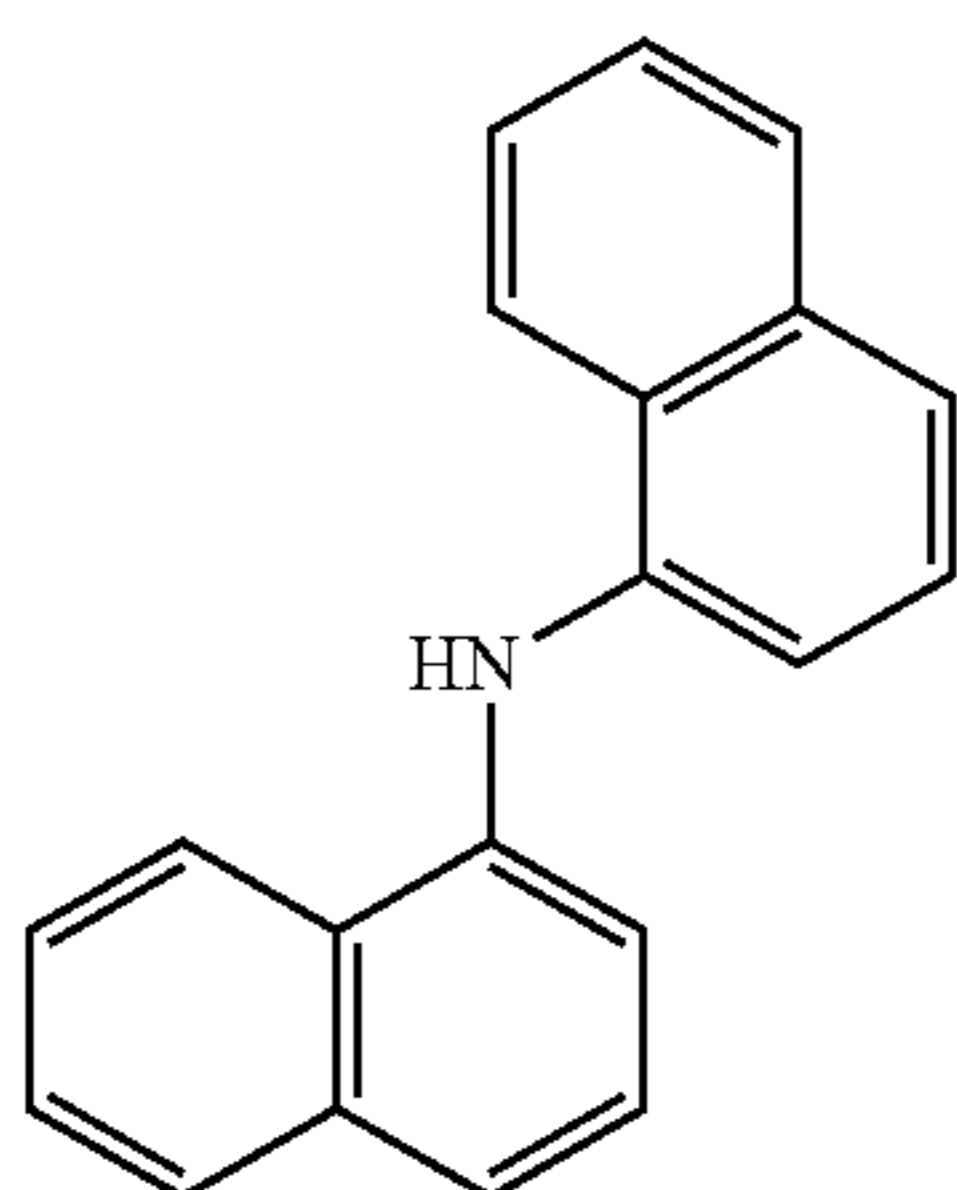
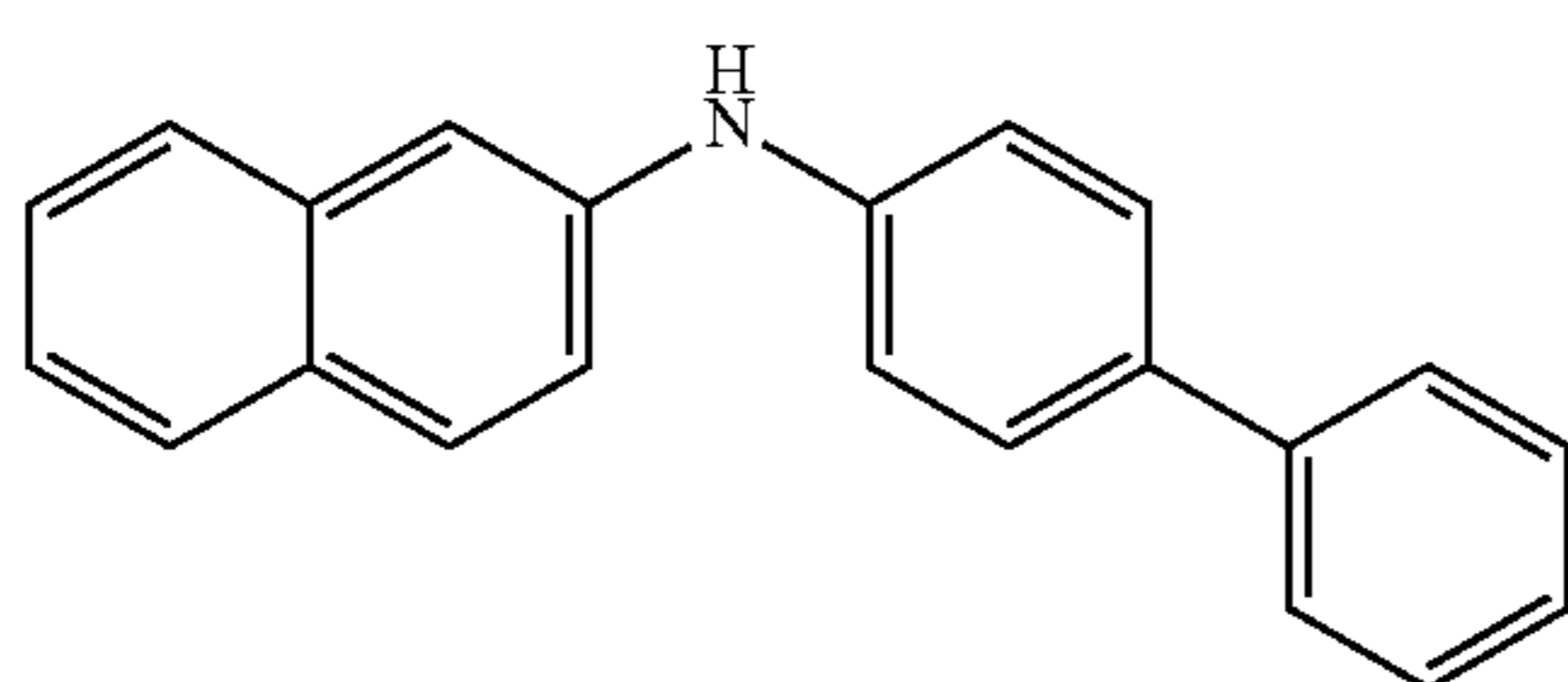
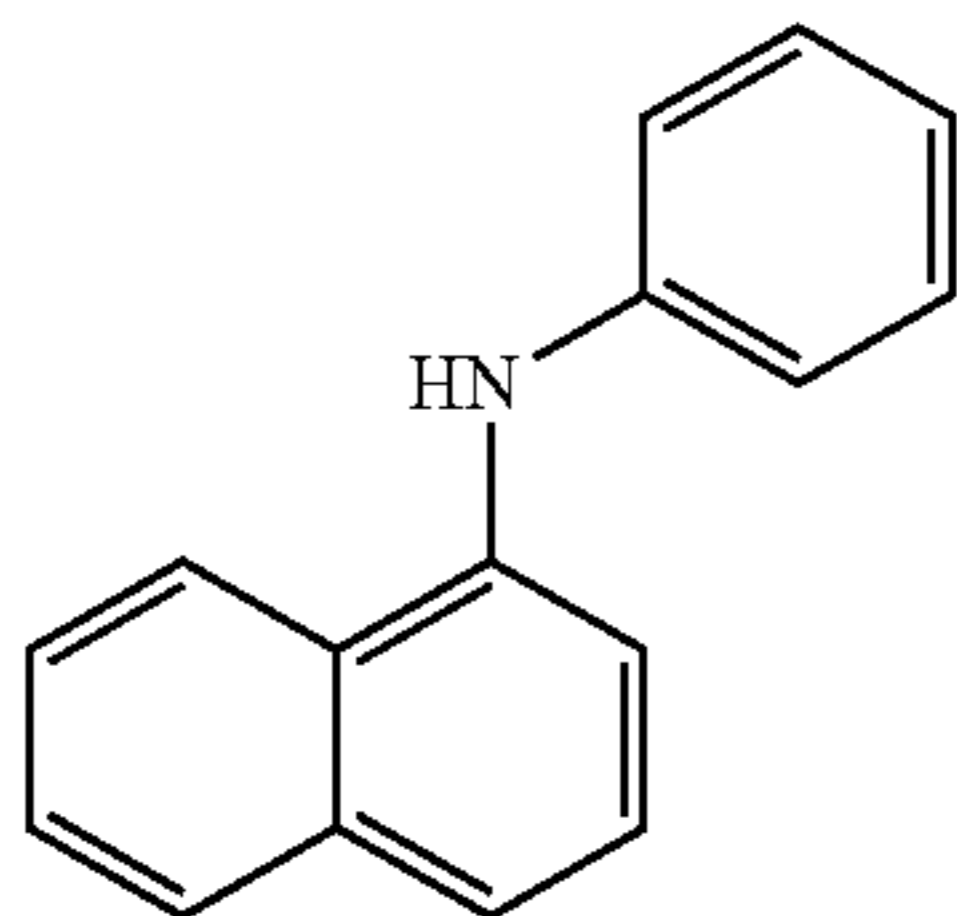


In a round bottom flask, 4-(dibenzo[b,d]furan-2-yl)aniline (15 g, 57.85 mmol), 2-bromodibenzo[b,d]furan (15.7 g, 63.63 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (2.65 g, 2.89 mmol), P(t-Bu)<sub>3</sub> (1.17 g, 5.78 mmol), NaOt-Bu (18.35 g, 190.9 mmol), toluene (607 mL) were tested in the same manner as Sub 2-1 to obtain 17.2 g of Sub 2-51. (Yield: 70%)



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The following Sub 2-1 to Sub 2-52 were synthesized in the same manner as in the synthesis method, but Sub 2 is not limited thereto.

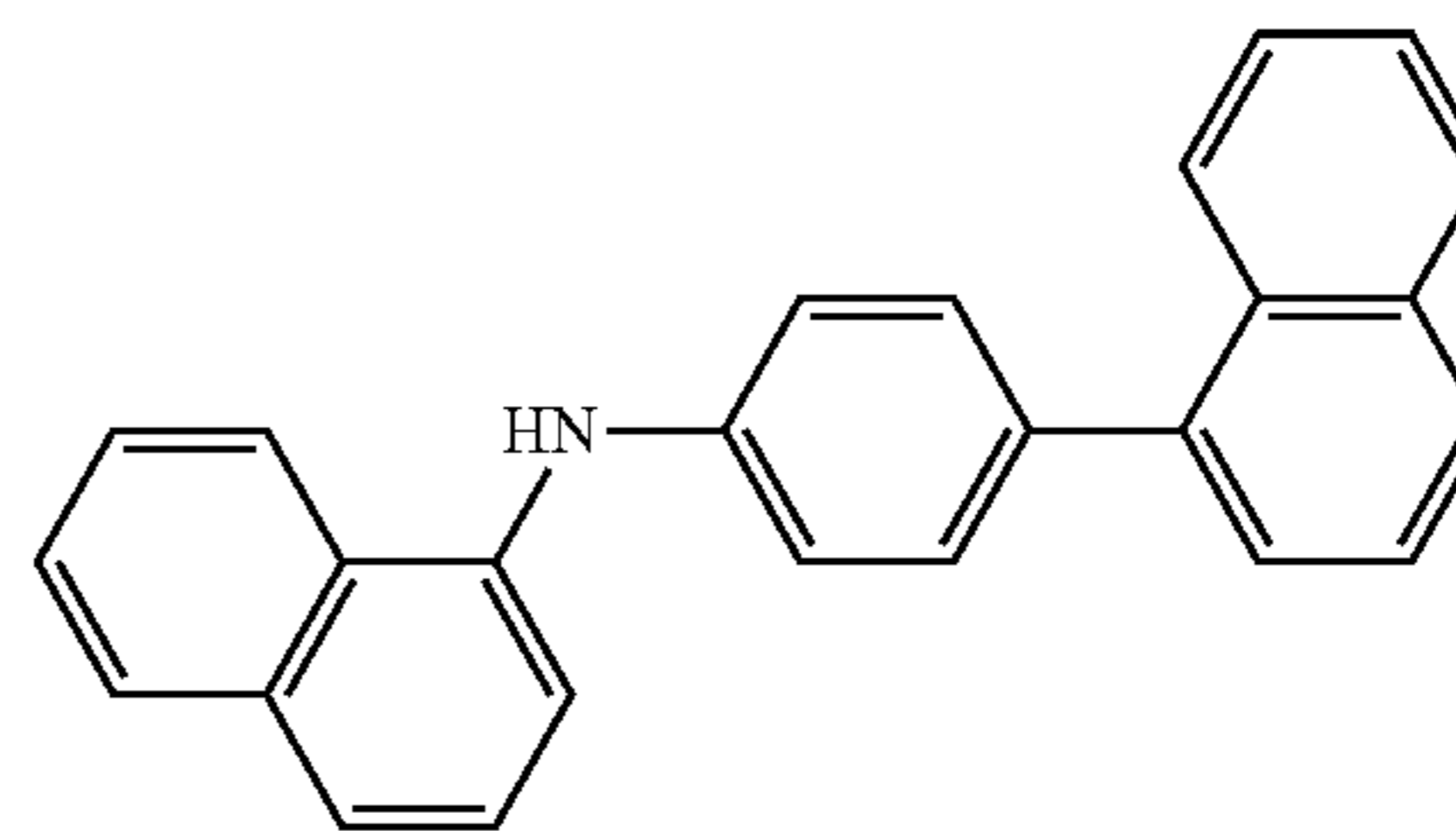


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Sub 2-1

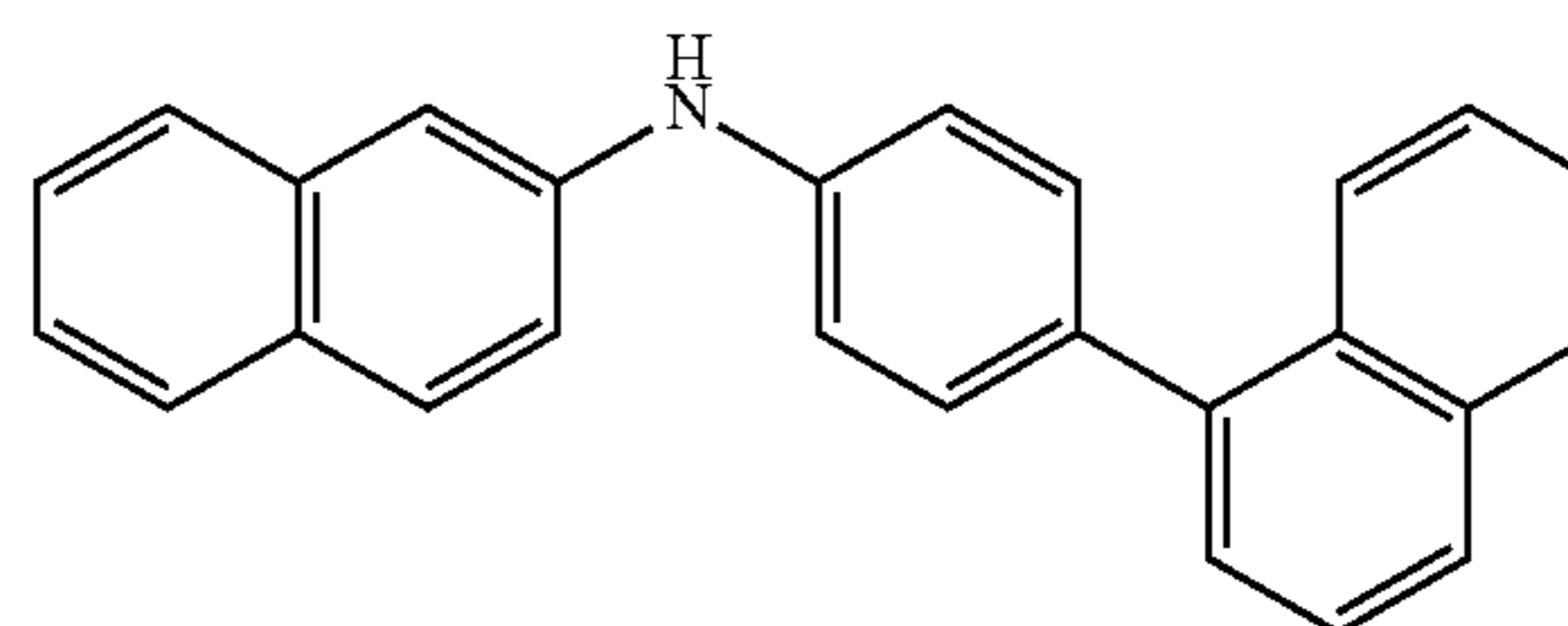
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Sub 2-8

Sub 2-2

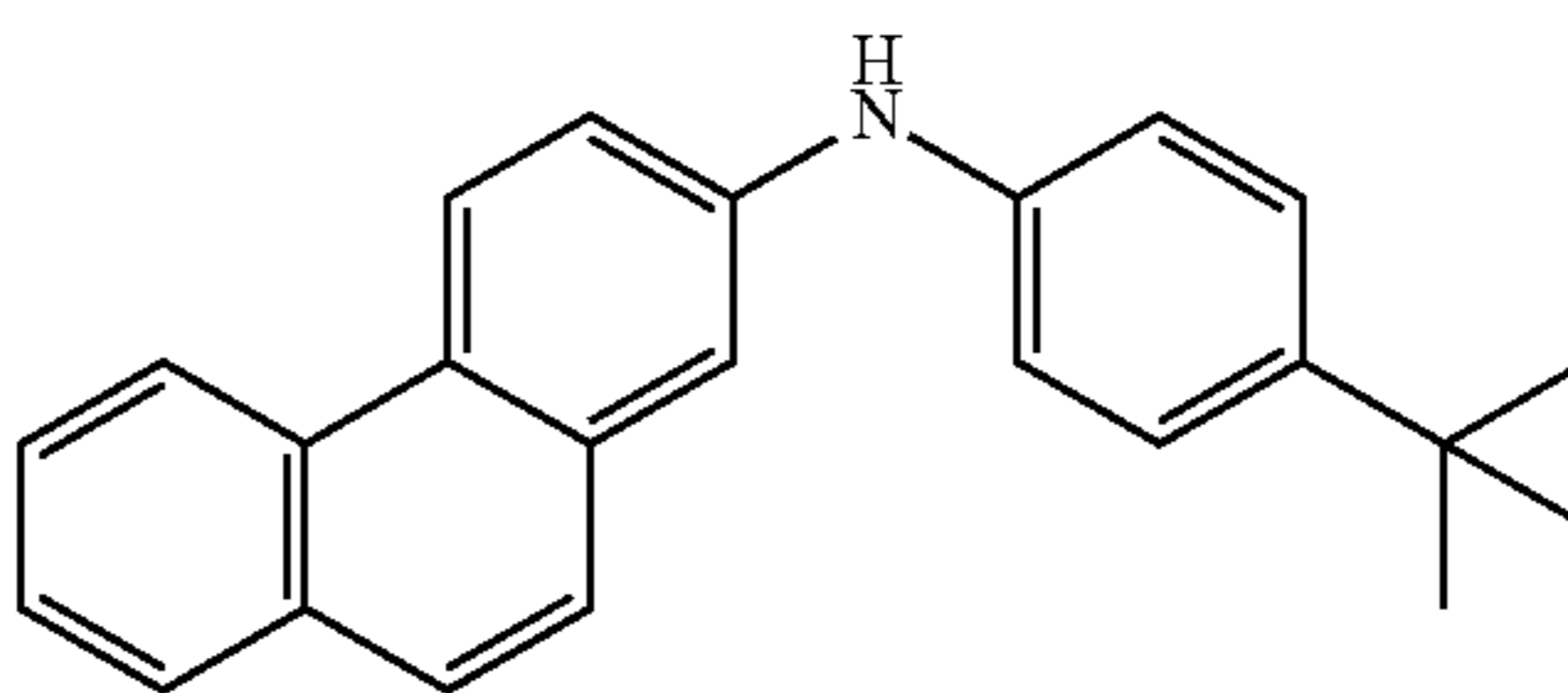
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Sub 2-9

Sub 2-3

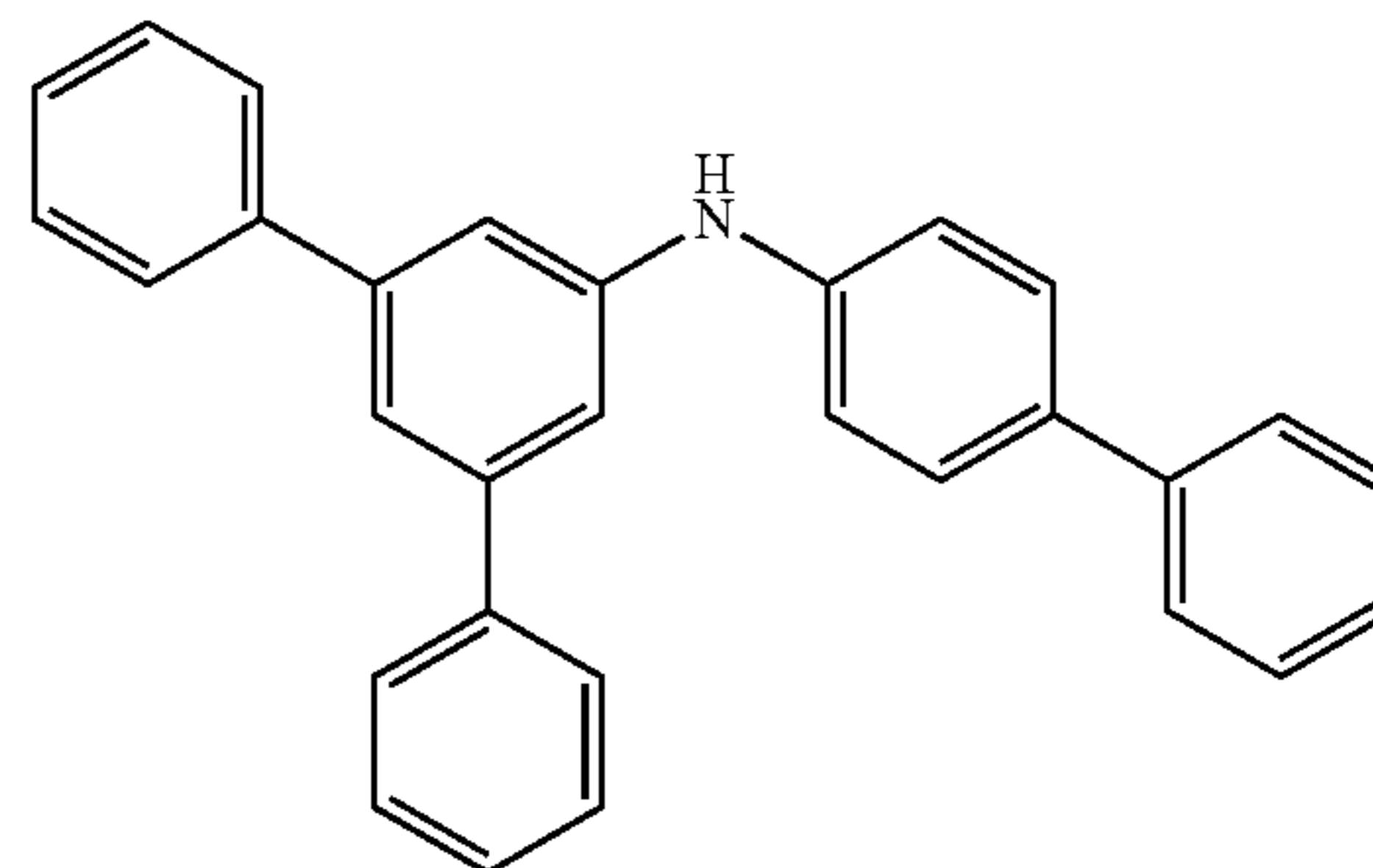
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Sub 2-10

Sub 2-4

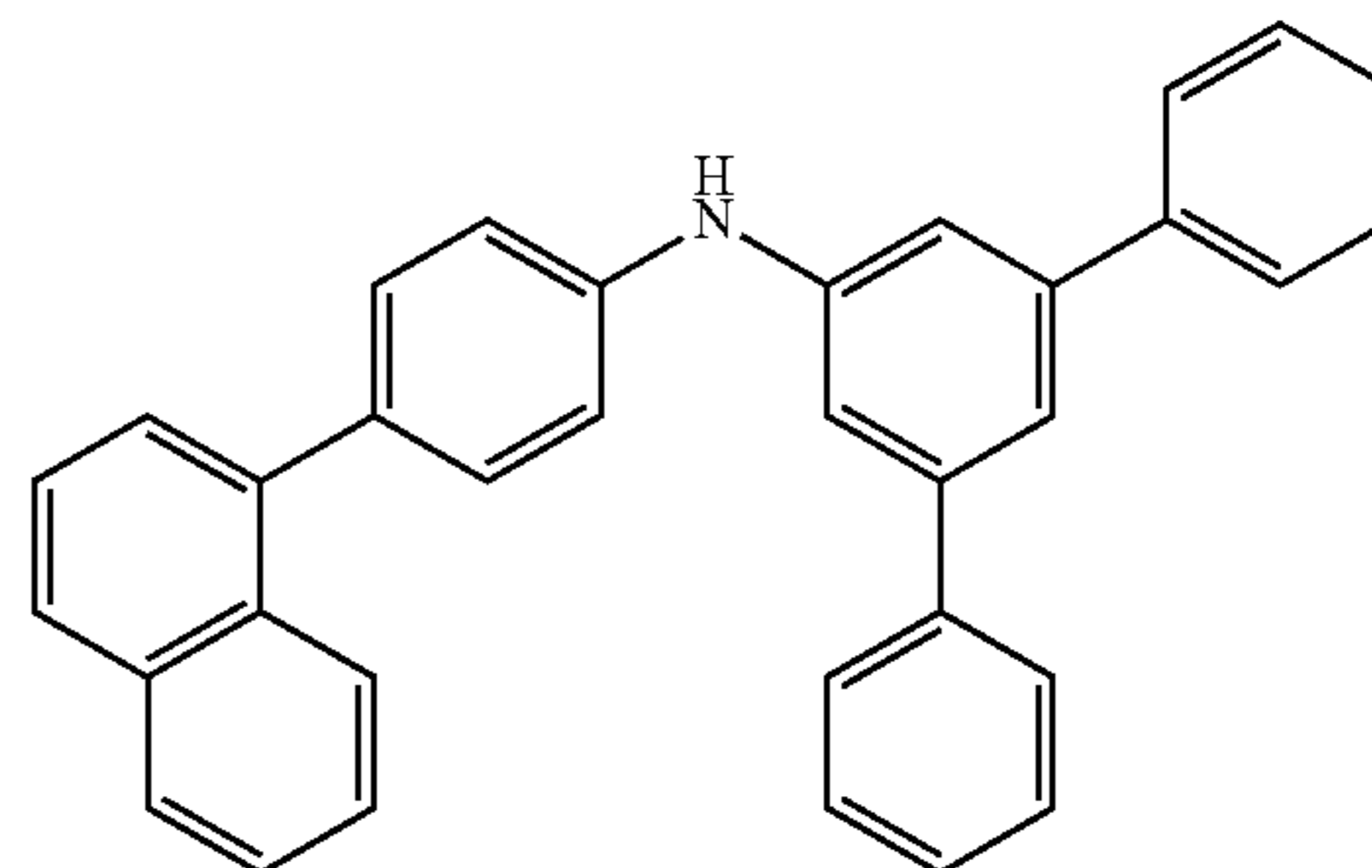
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Sub 2-11

Sub 2-5

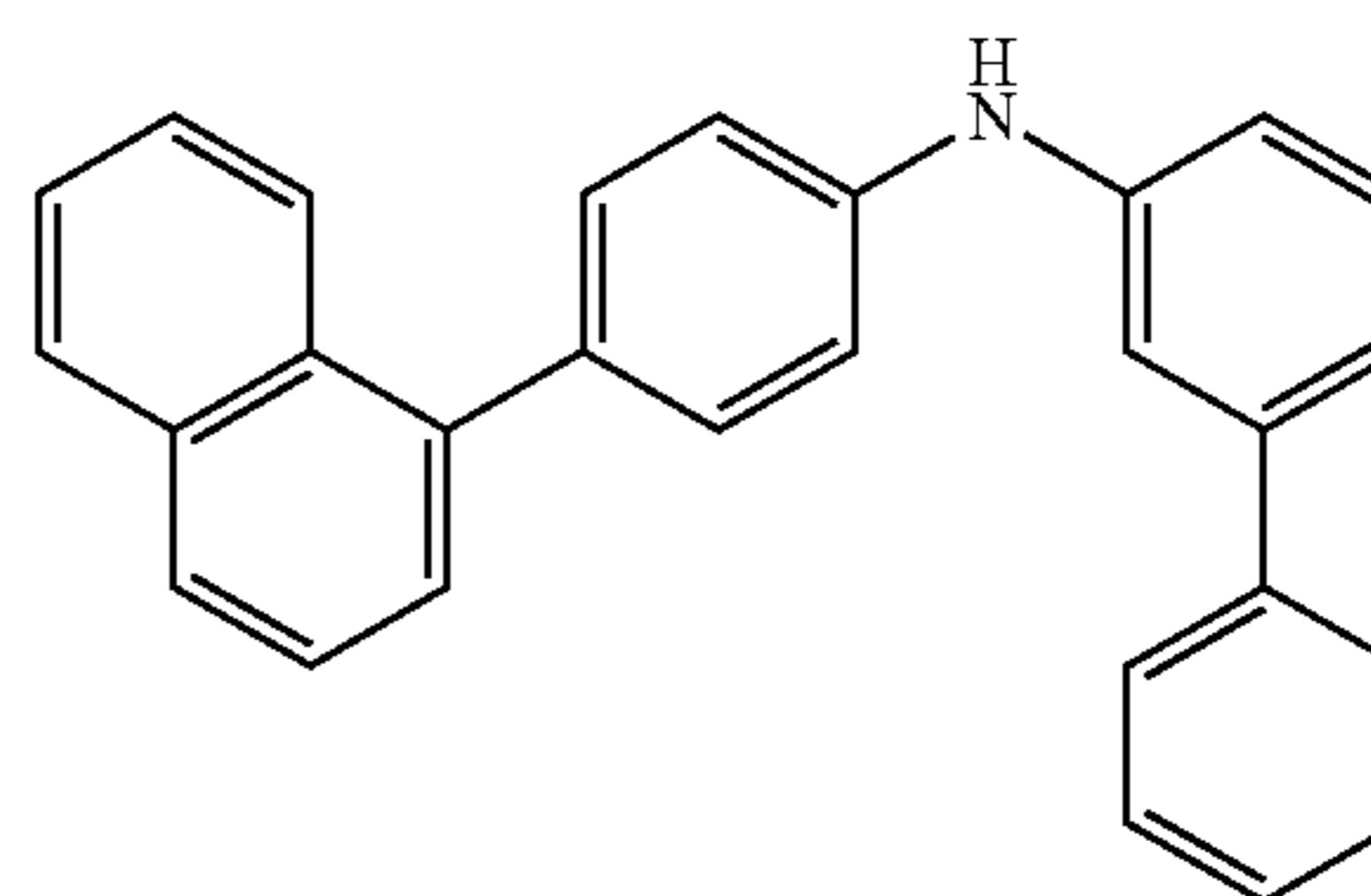
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Sub 2-12

Sub 2-6

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Sub 2-13

Sub 2-7

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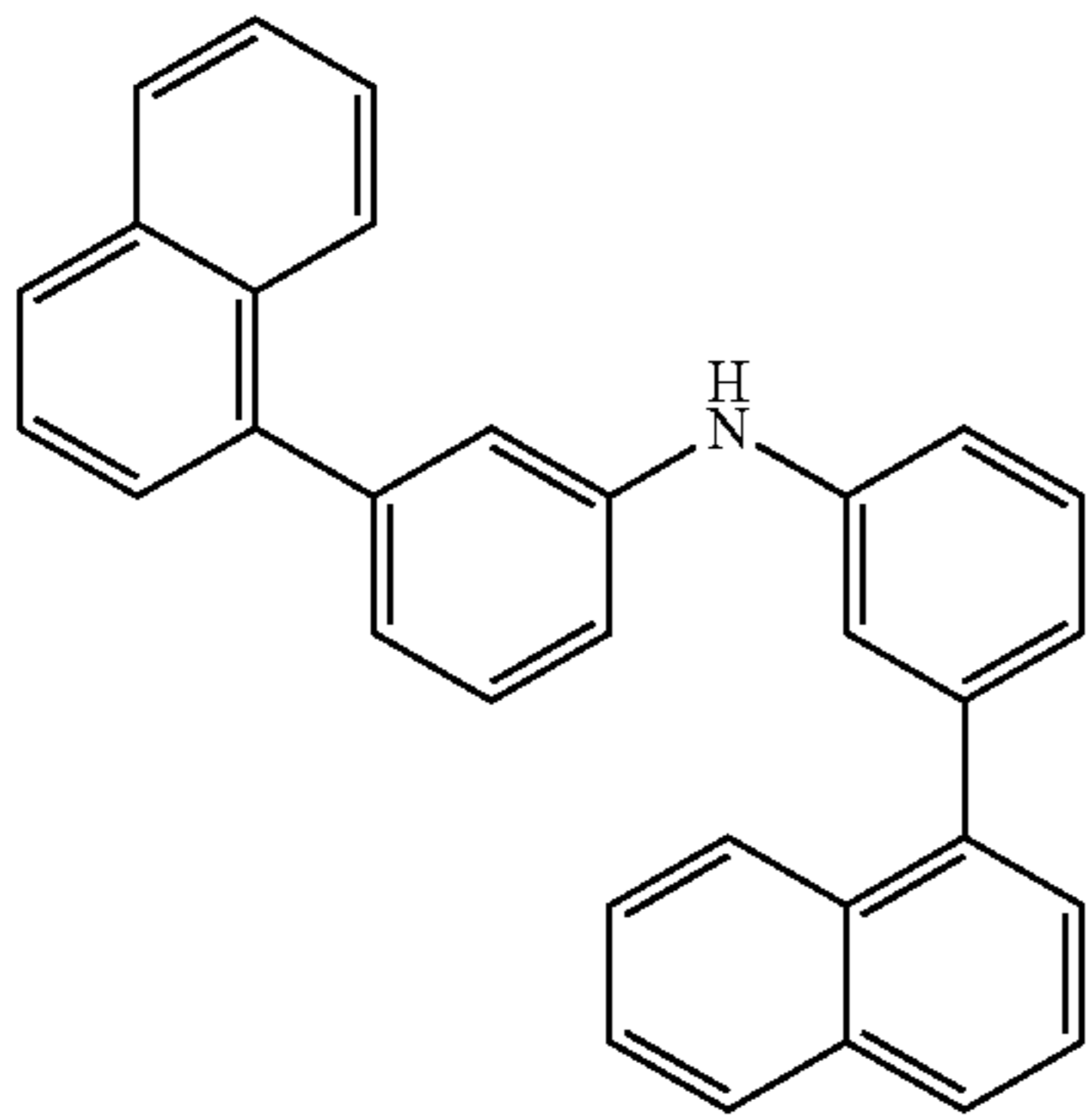
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93

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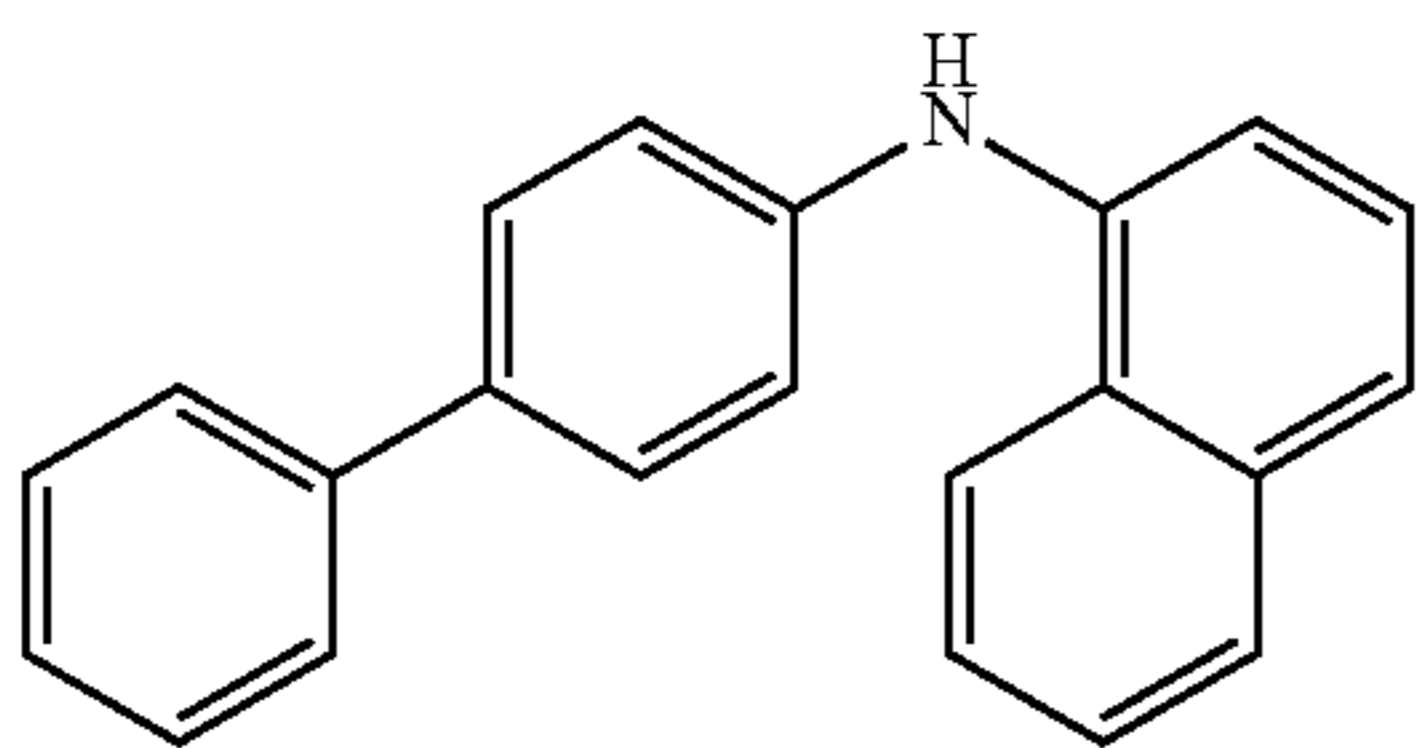
Sub 2-14

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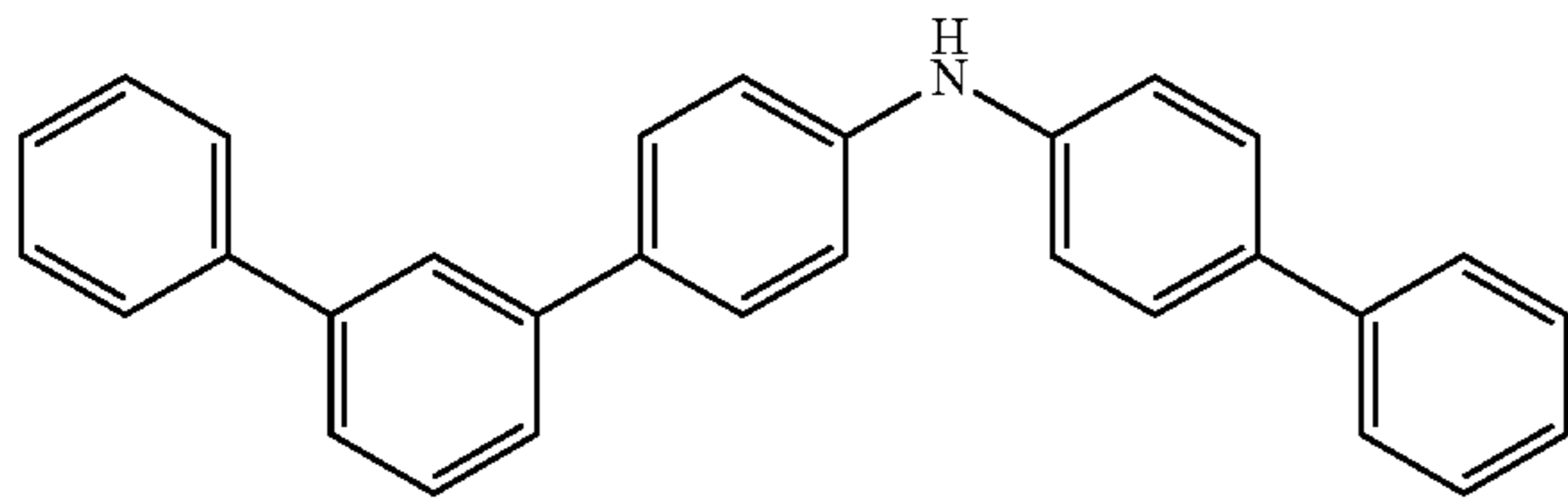
Sub 2-15



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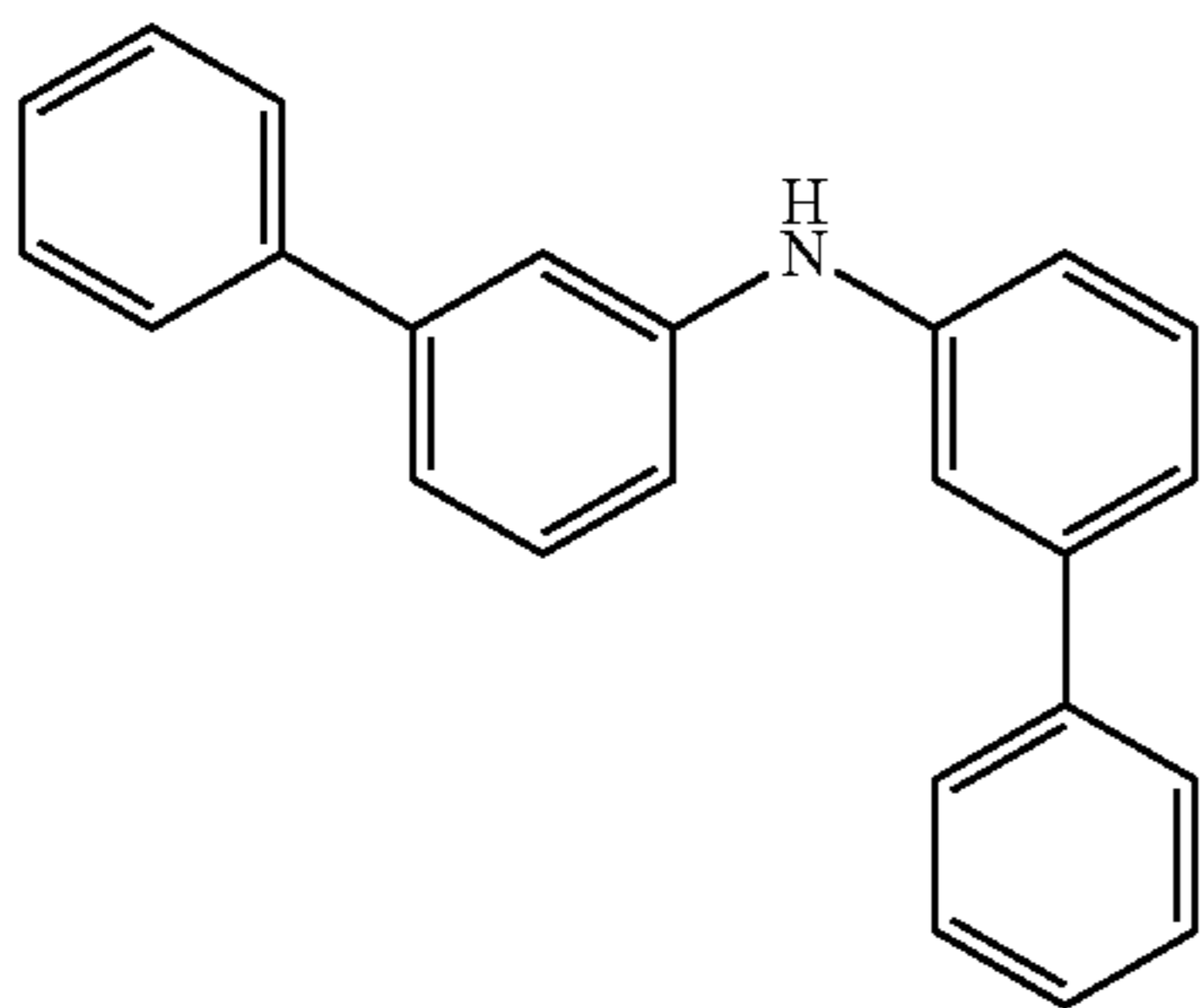
Sub 2-16



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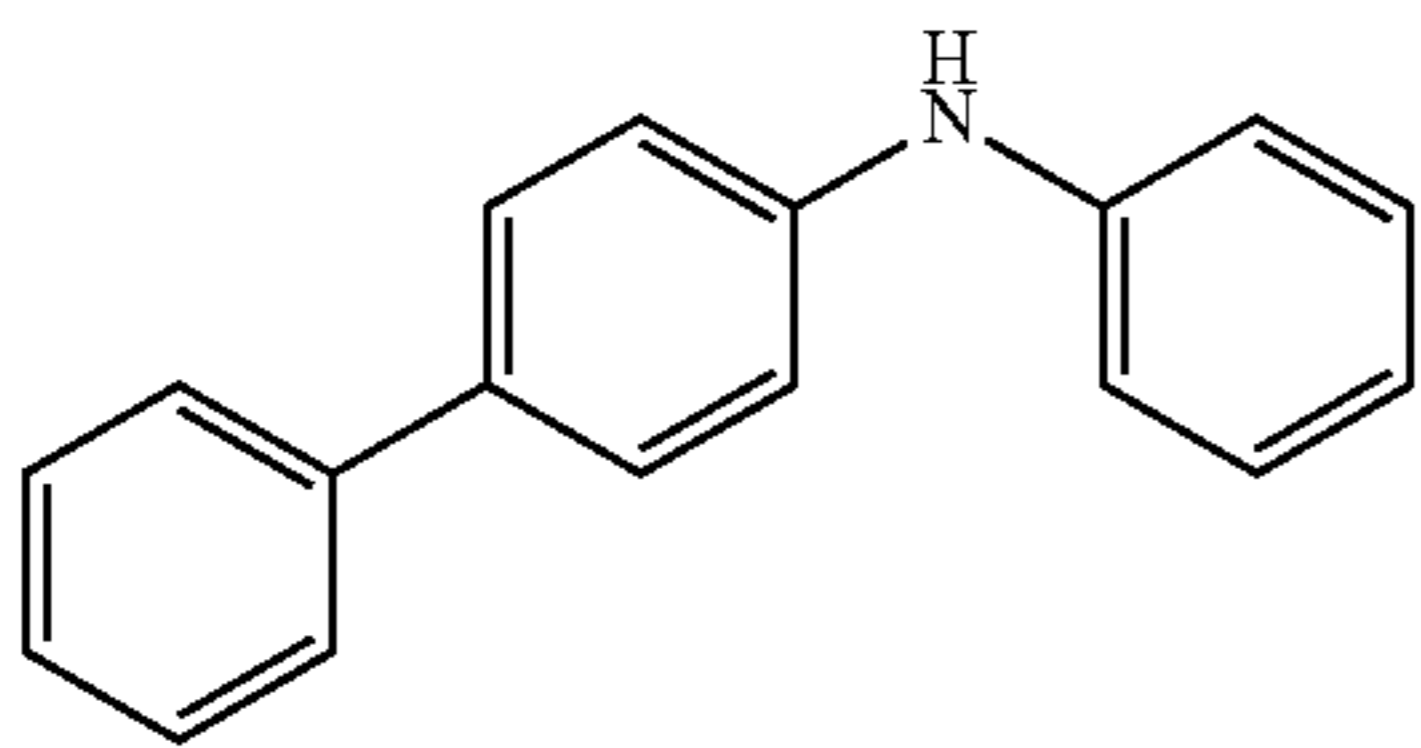
Sub 2-17



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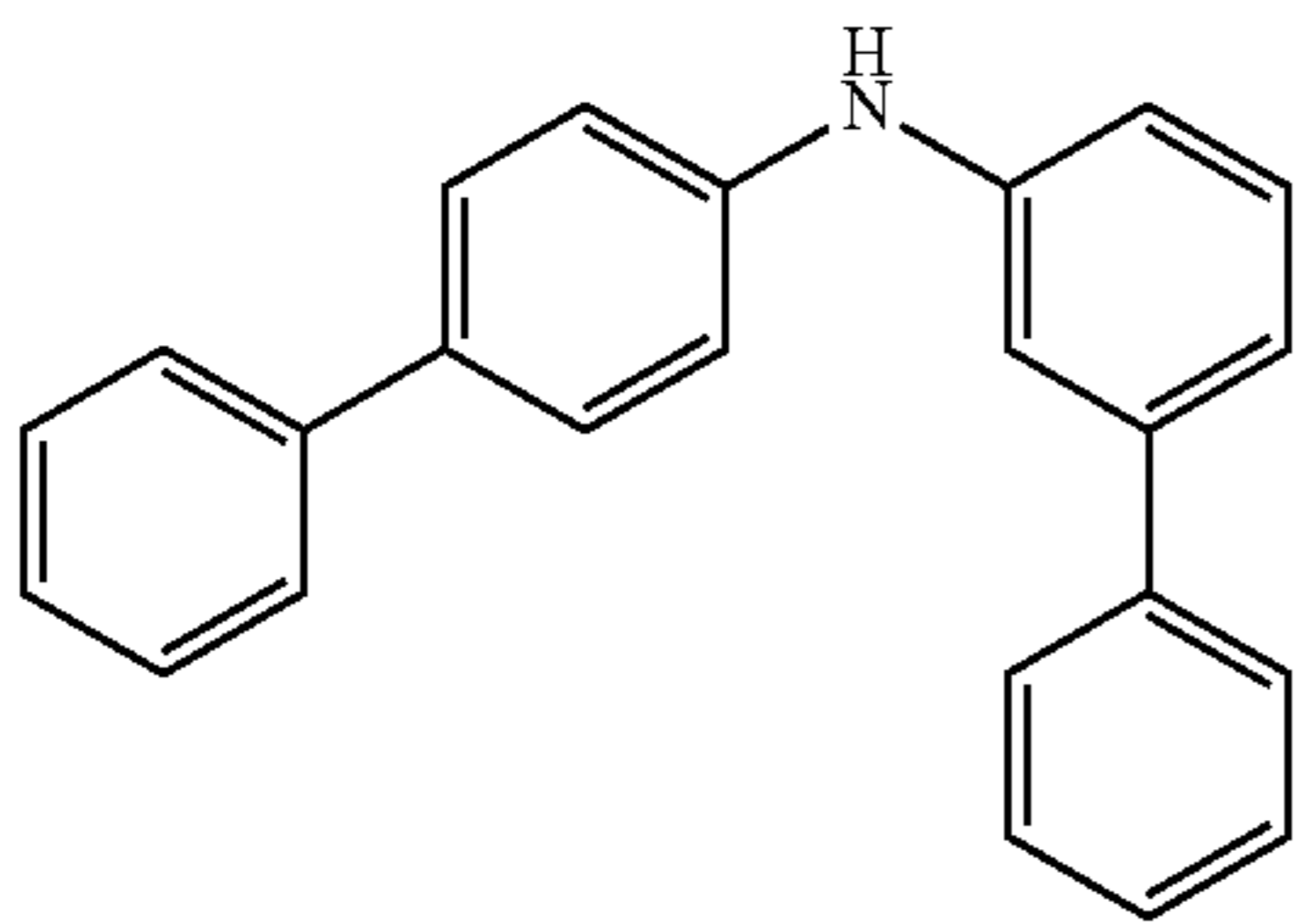
Sub 2-18



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Sub 2-19

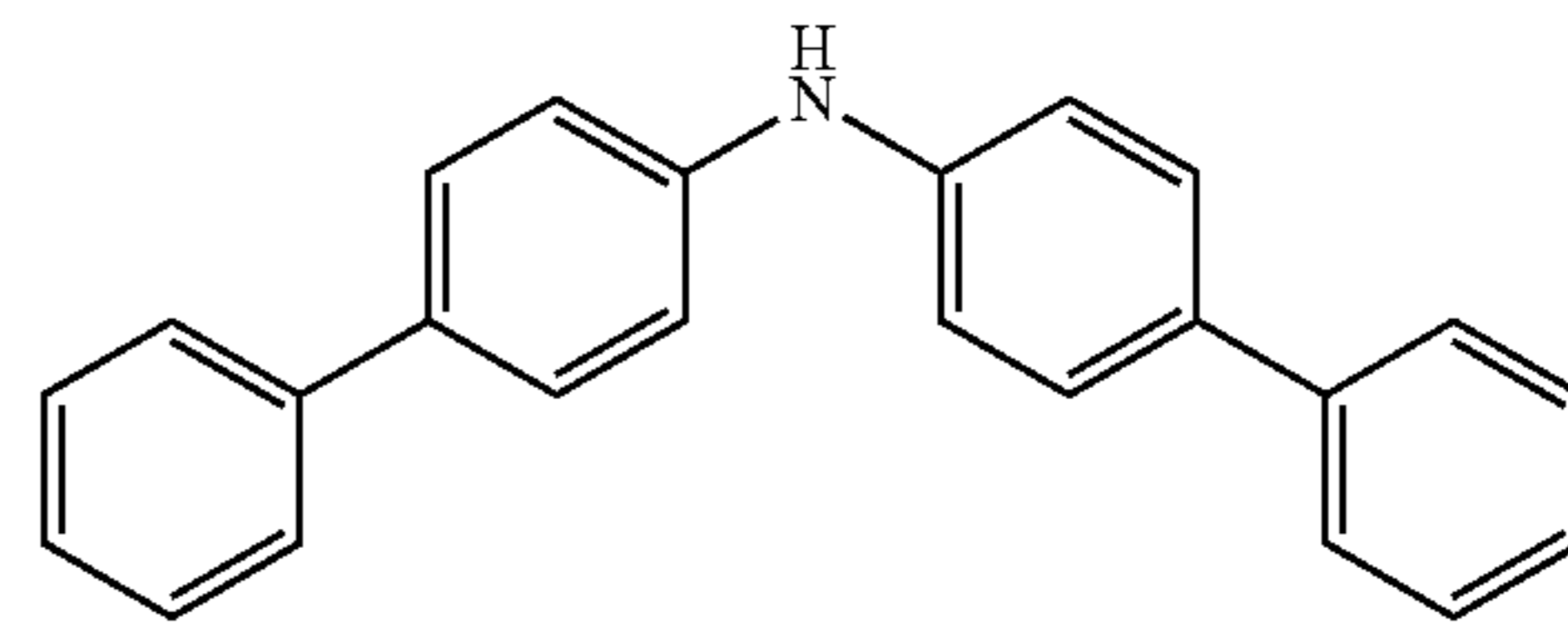


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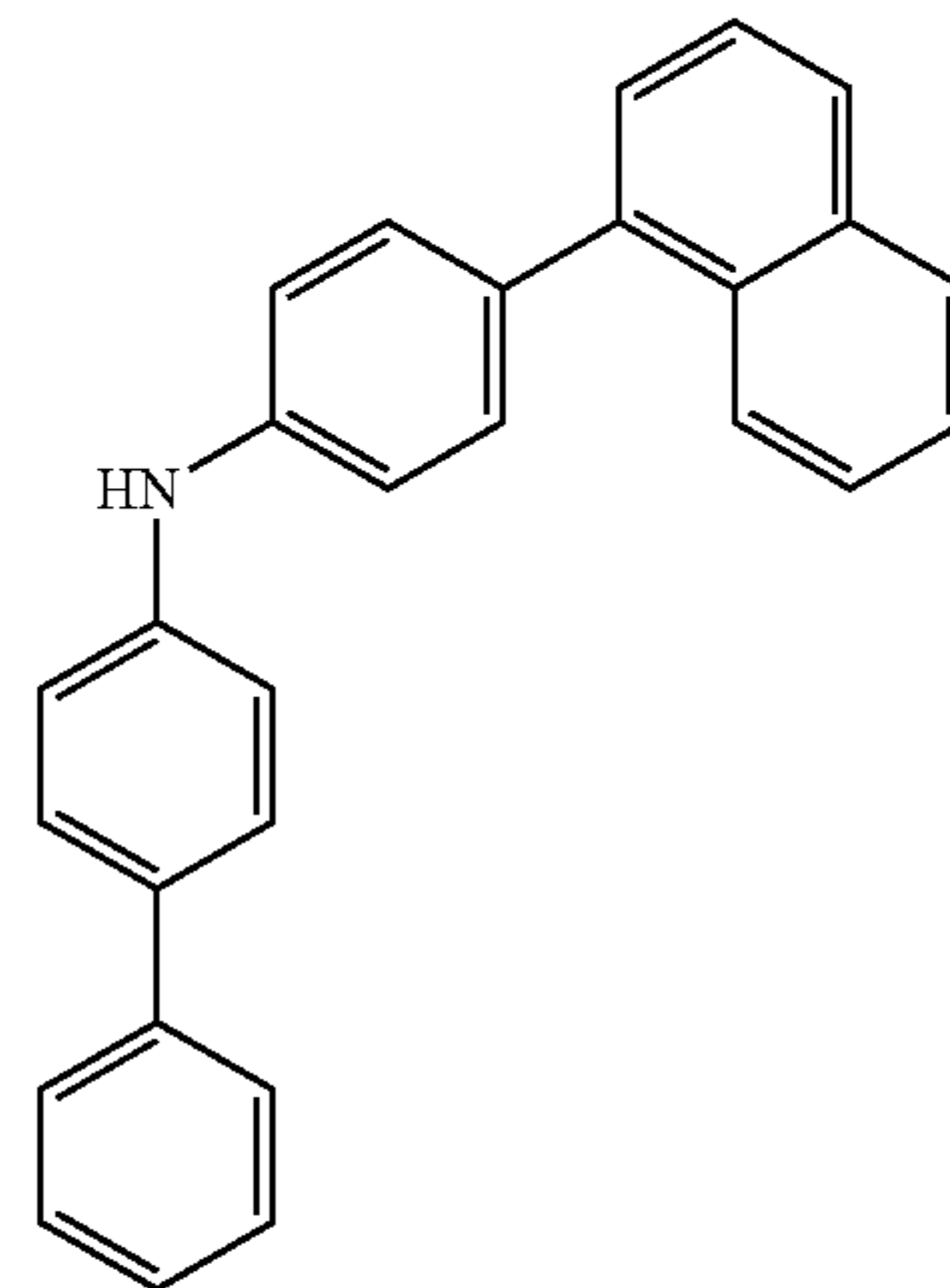
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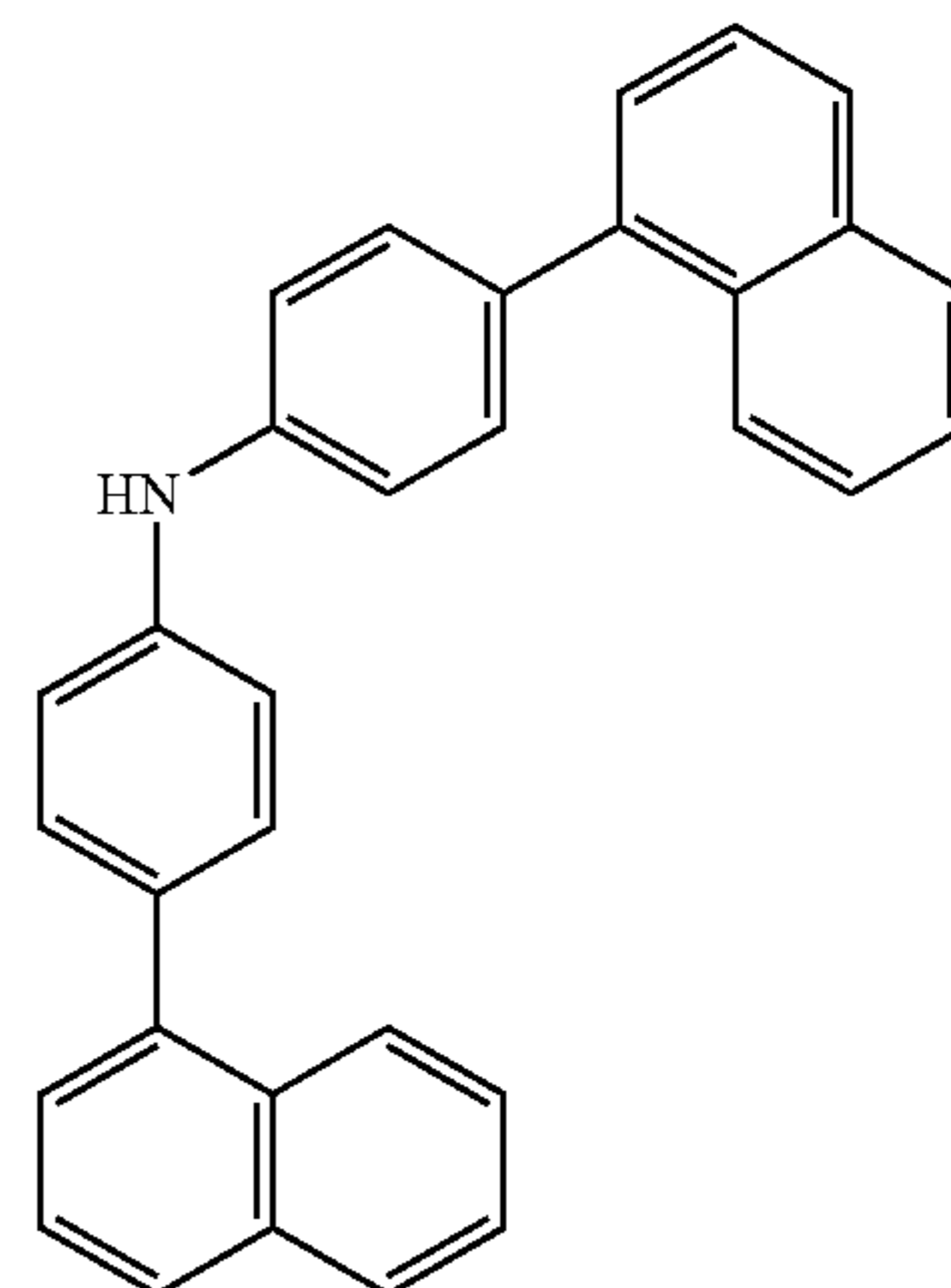


Sub 2-20

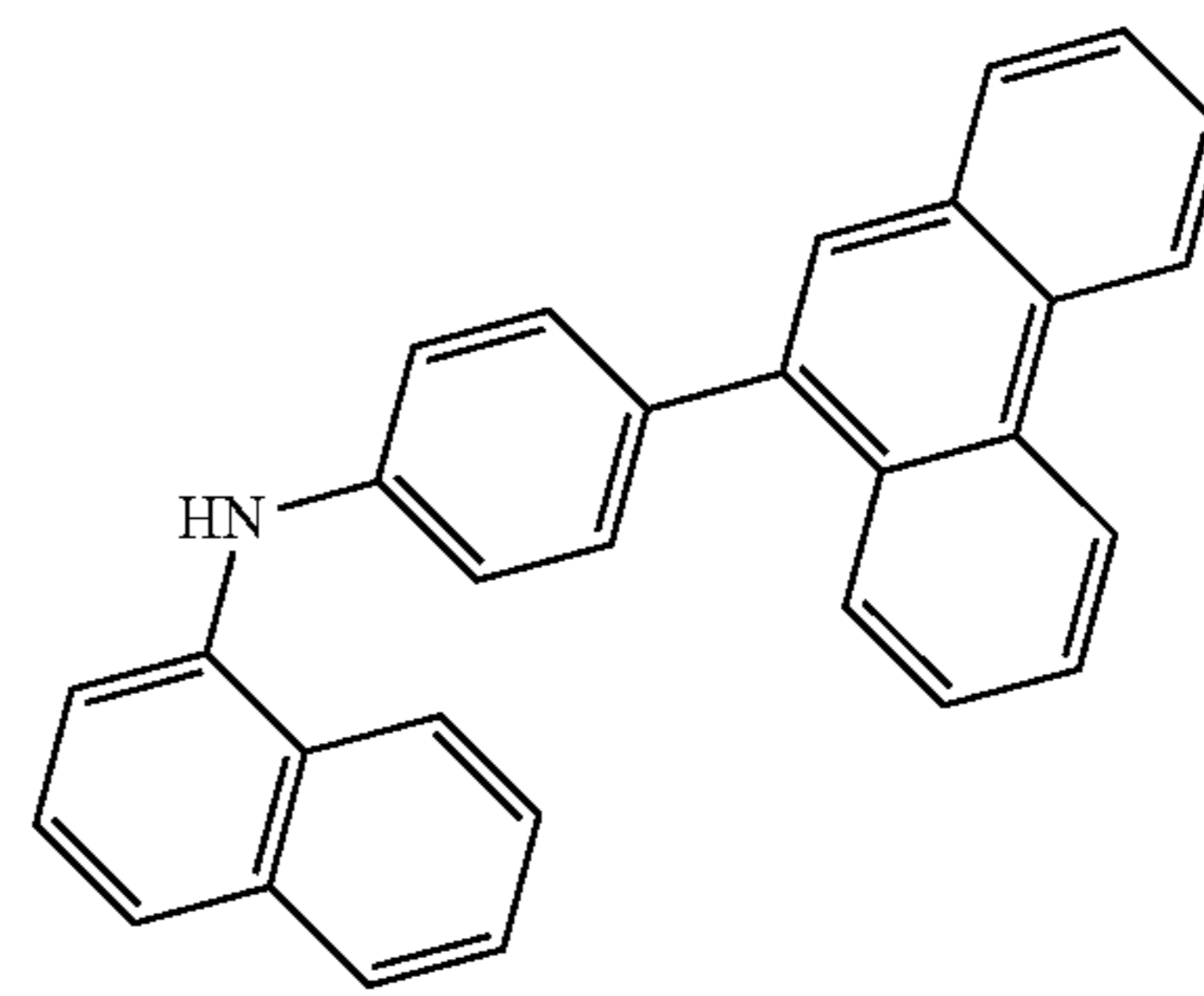
Sub 2-21



Sub 2-22

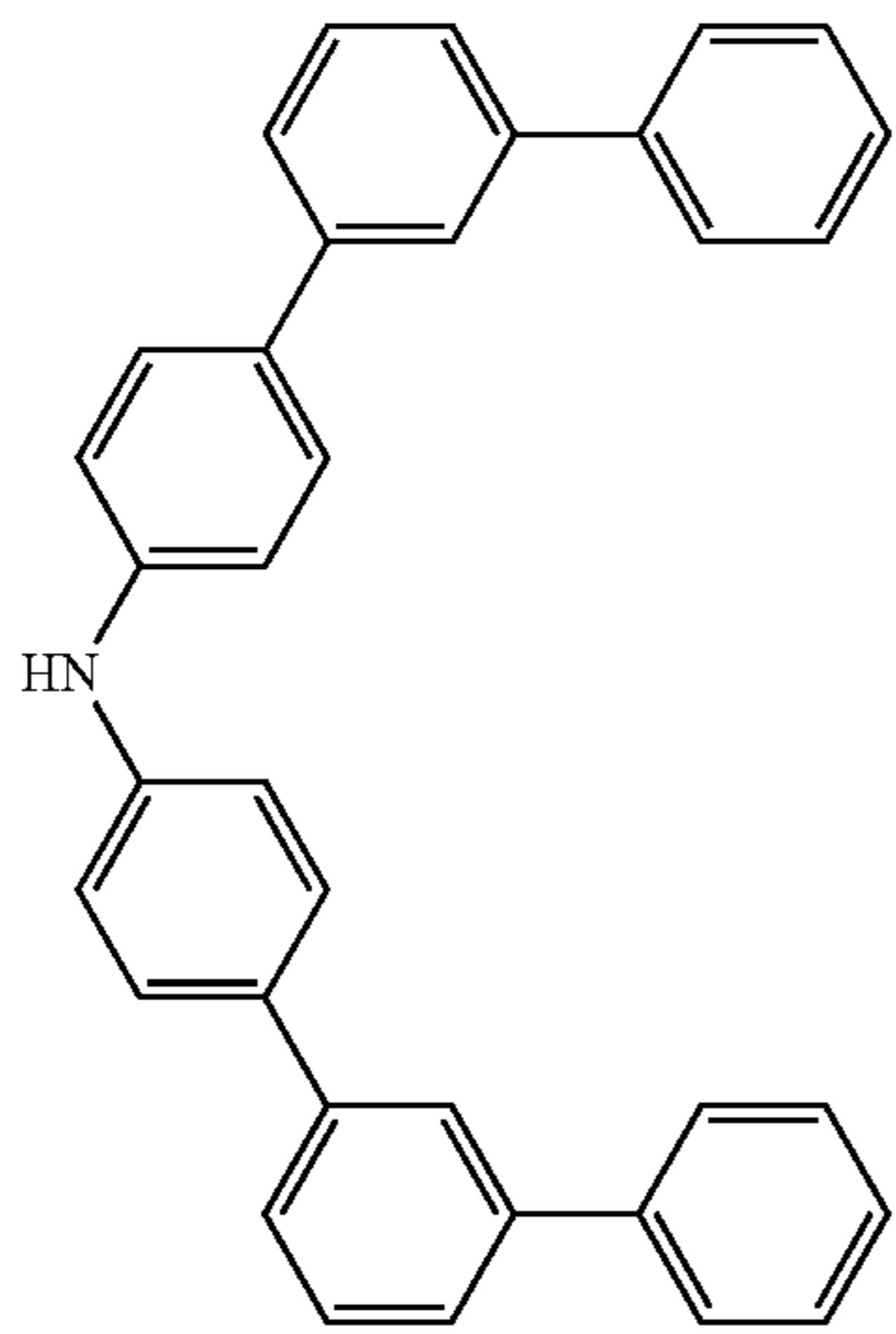


Sub 2-23



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Sub 2-24

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Sub 2-25

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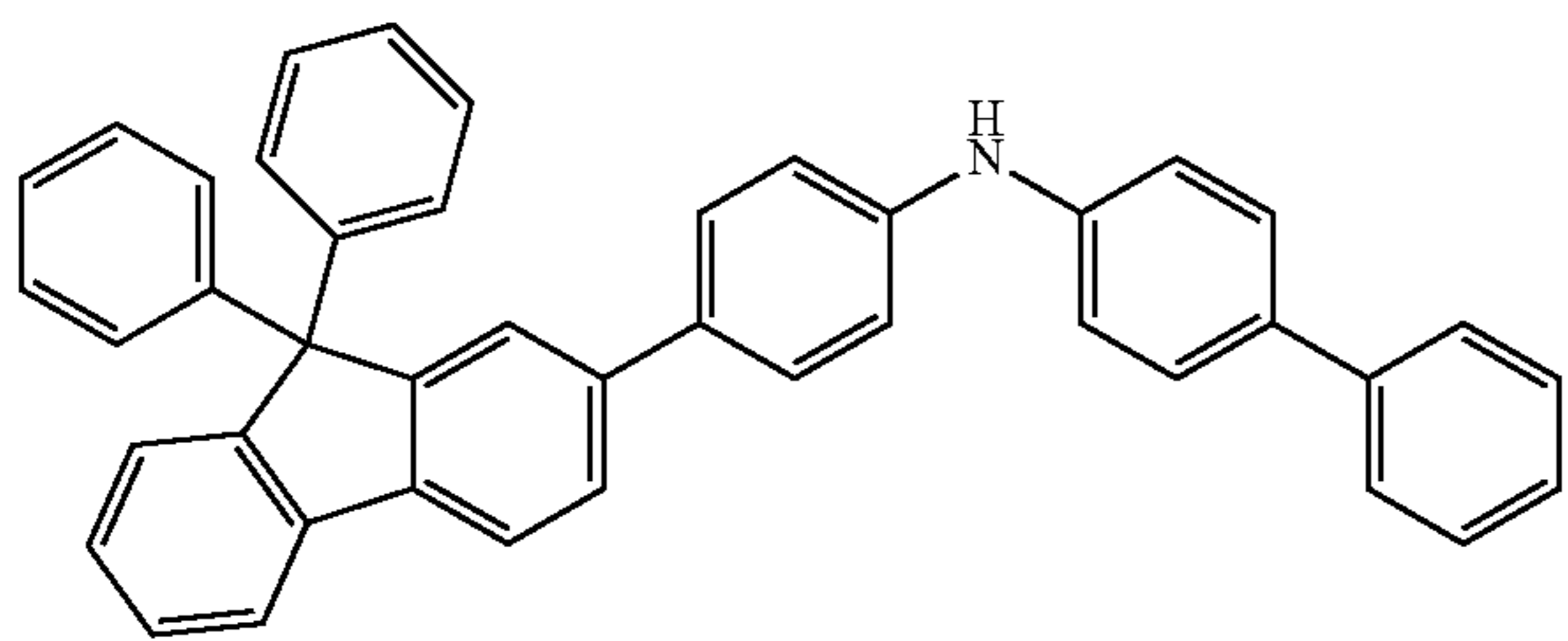
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Sub 2-26

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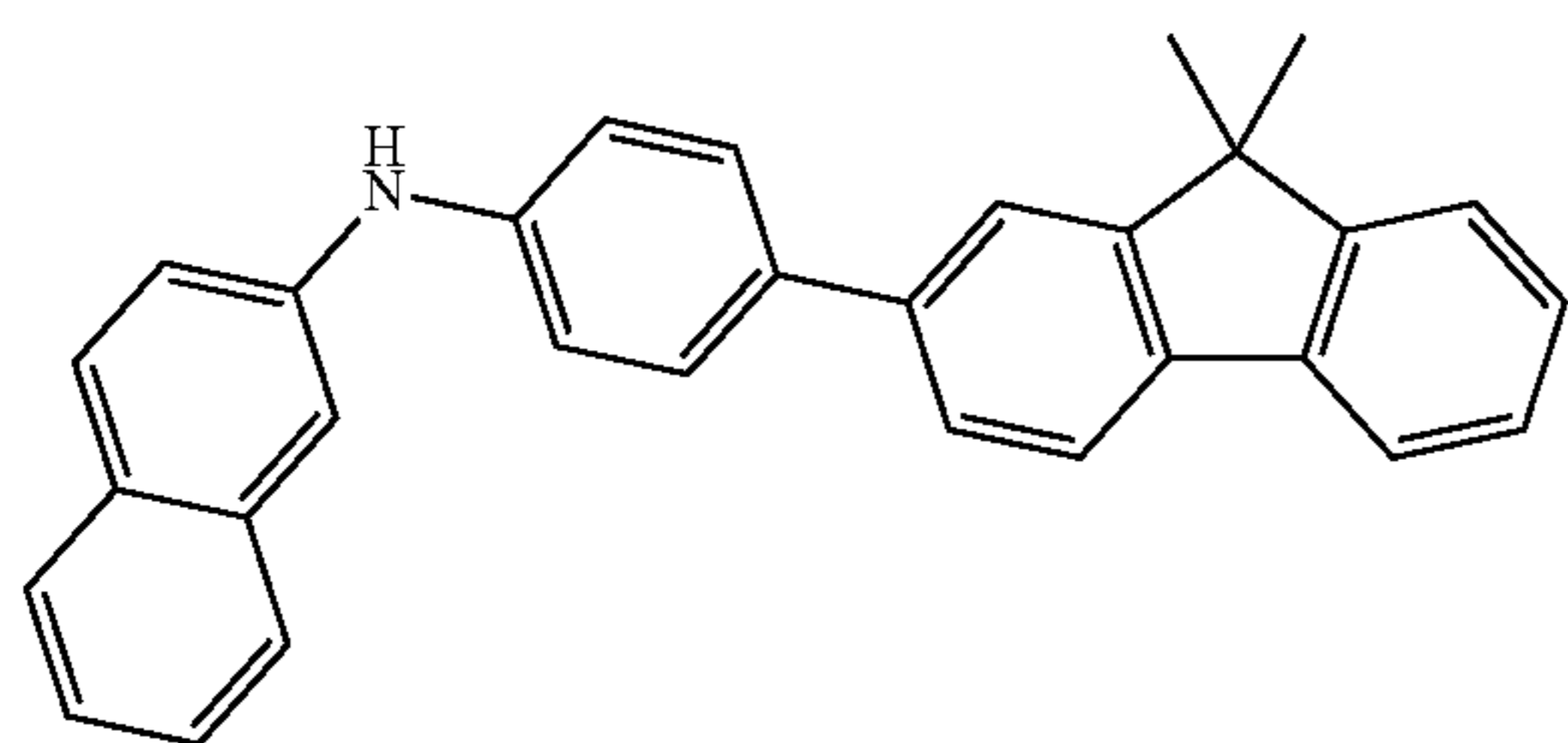
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Sub 2-27

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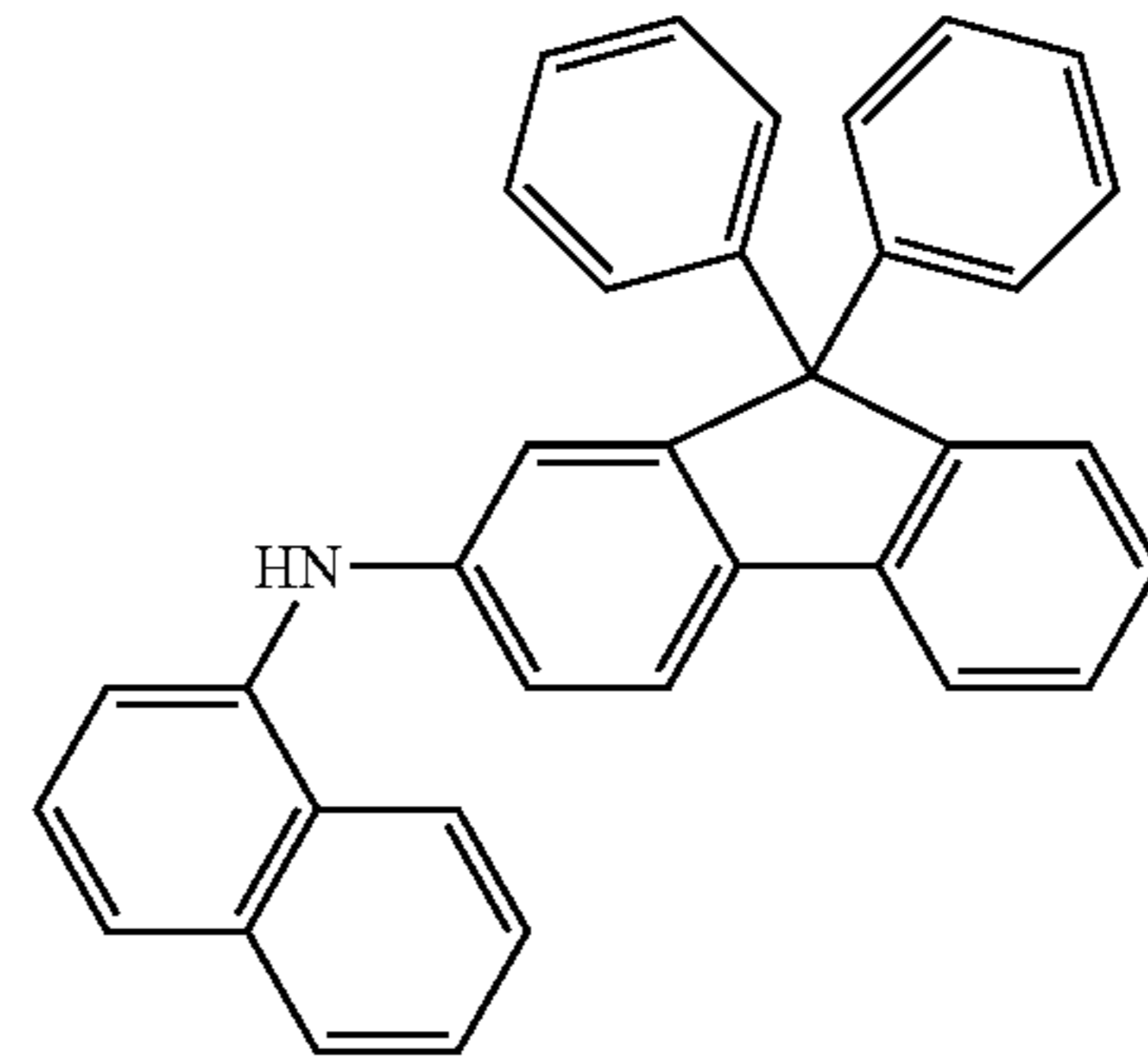
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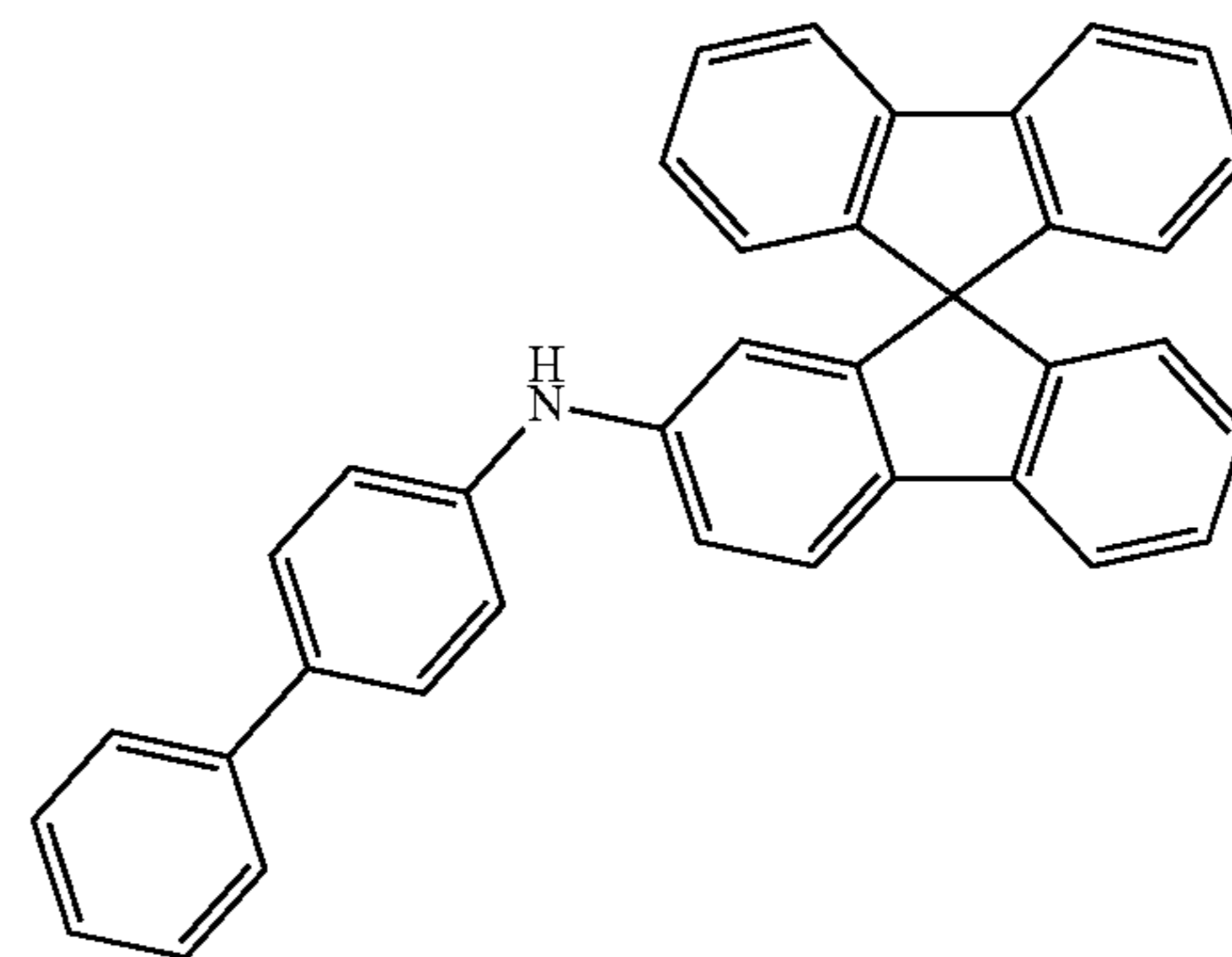
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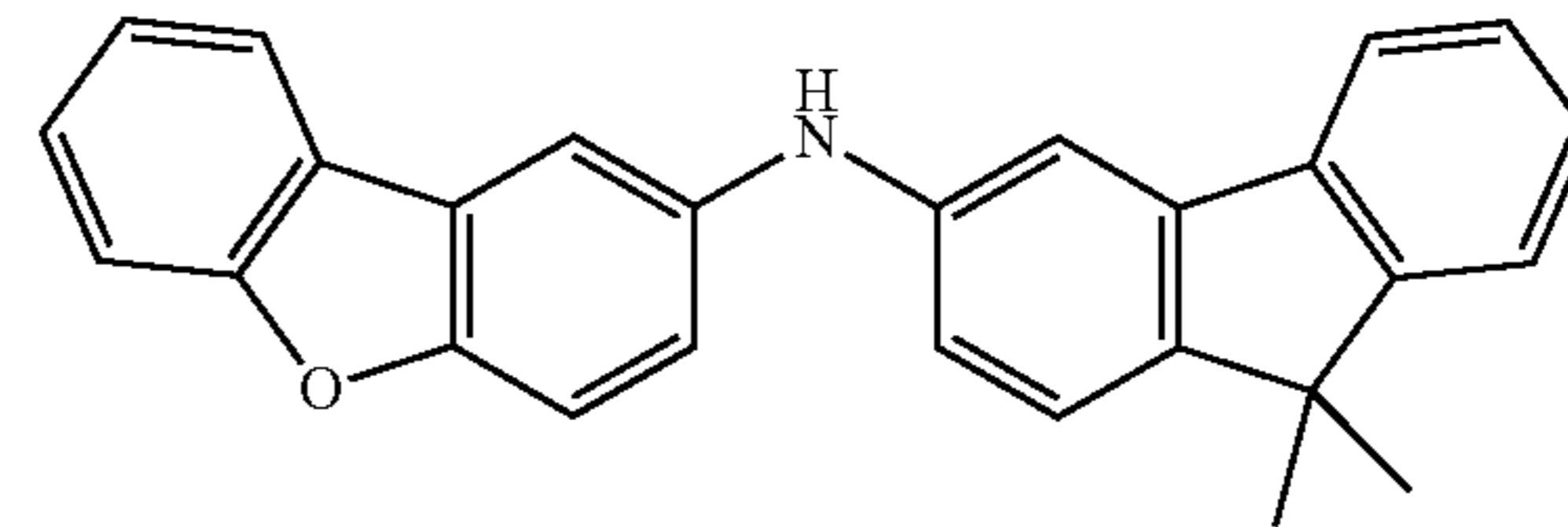
Sub 2-28



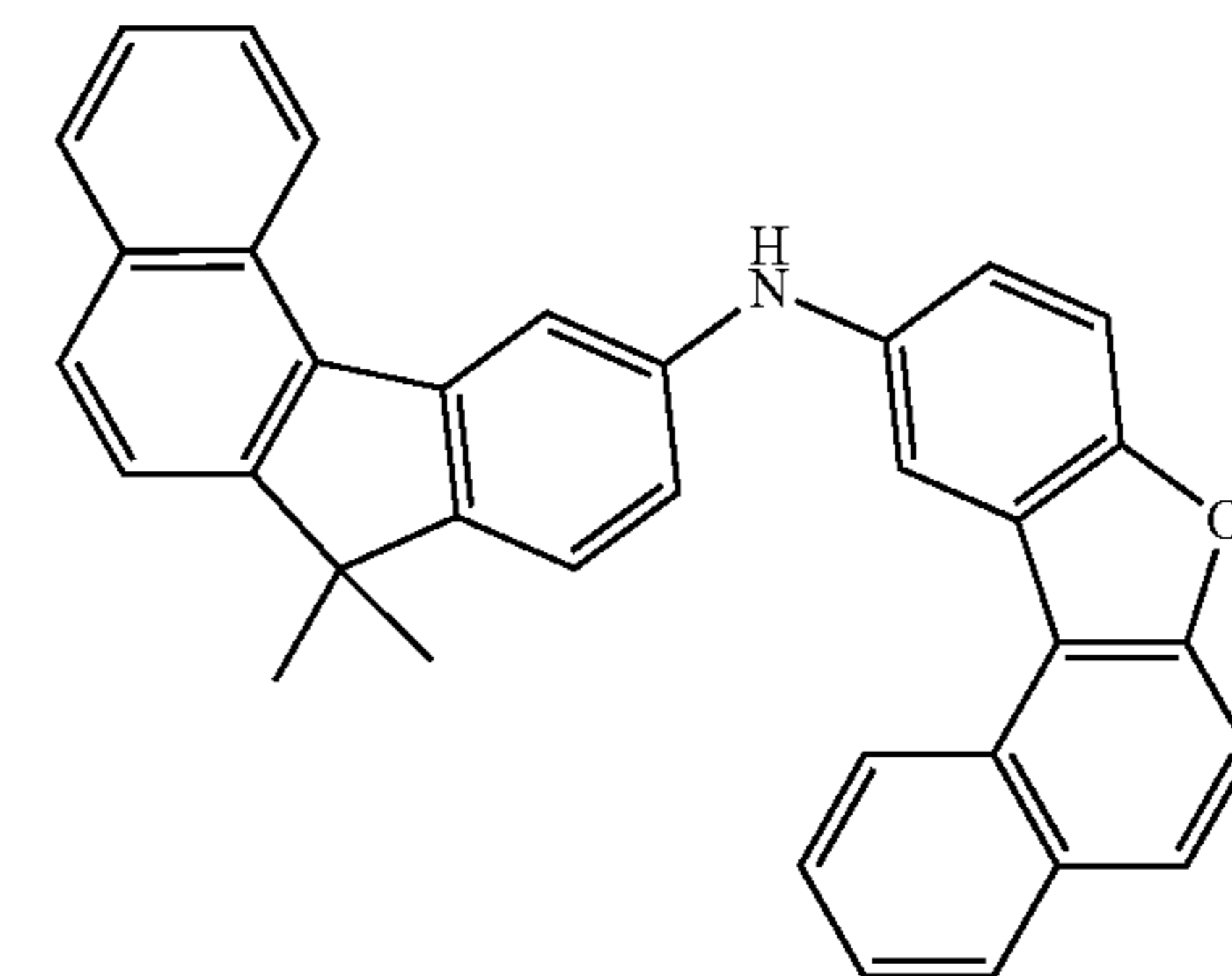
Sub 2-29



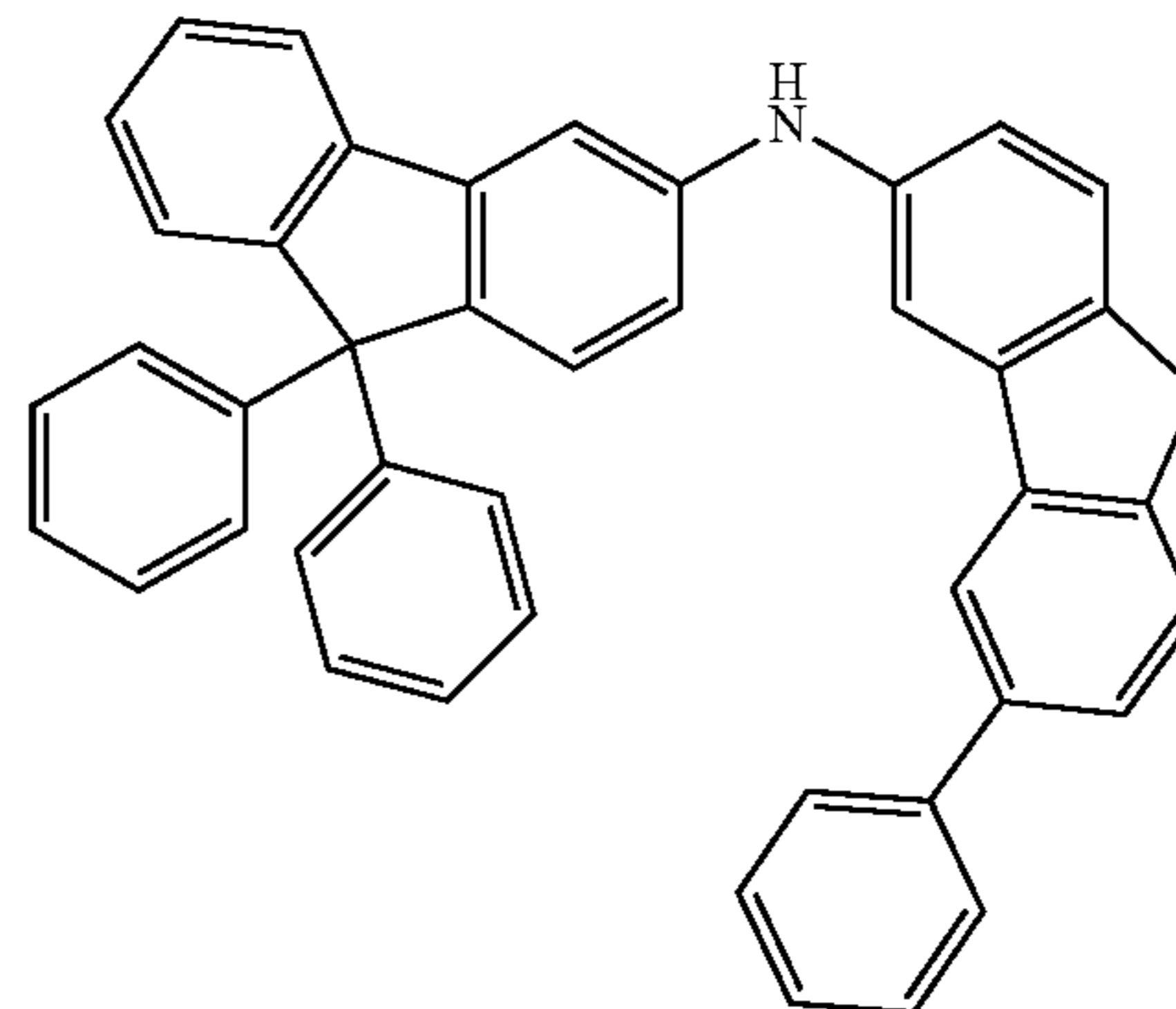
Sub 2-30



Sub 2-31

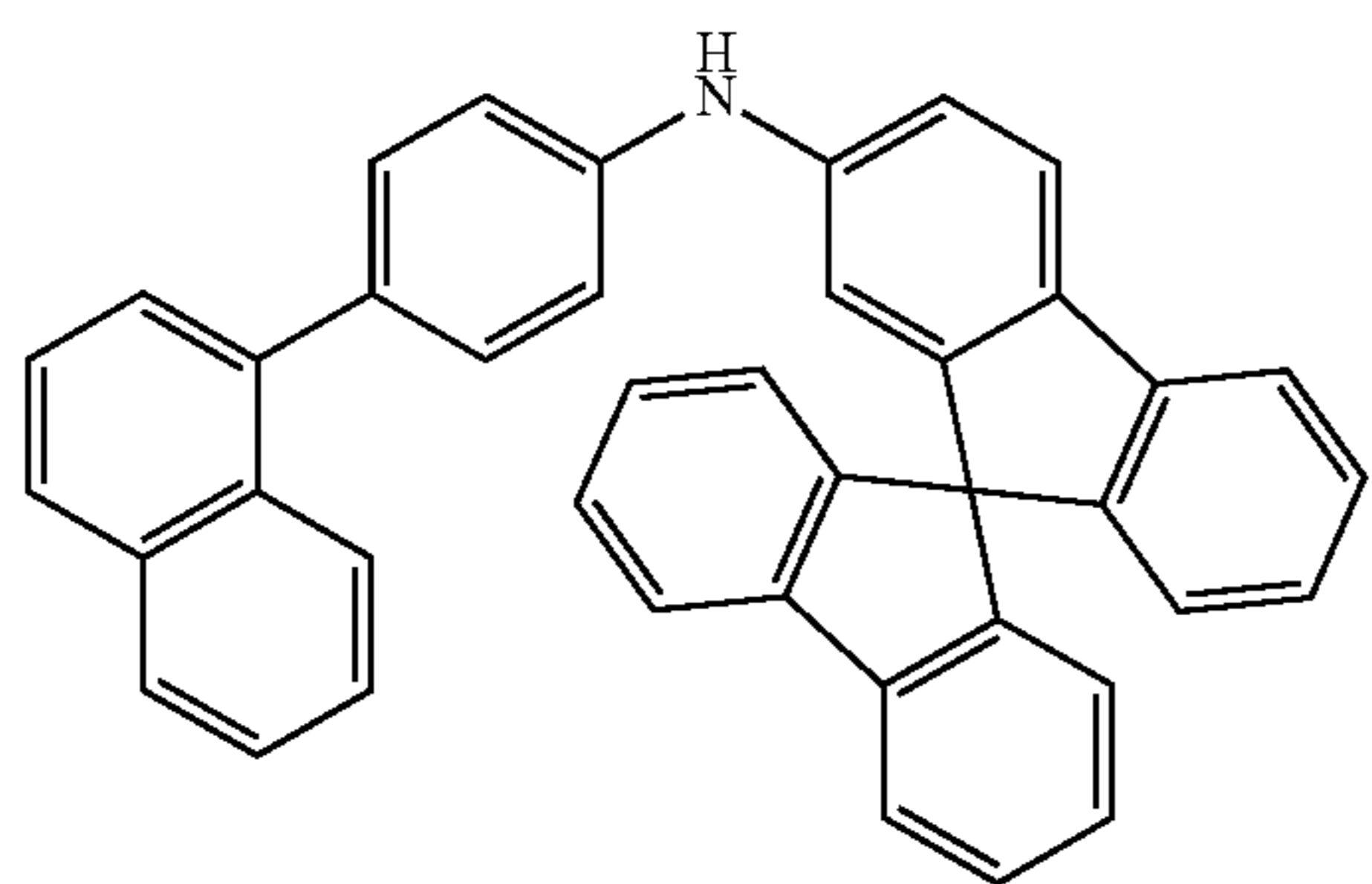


Sub 2-32



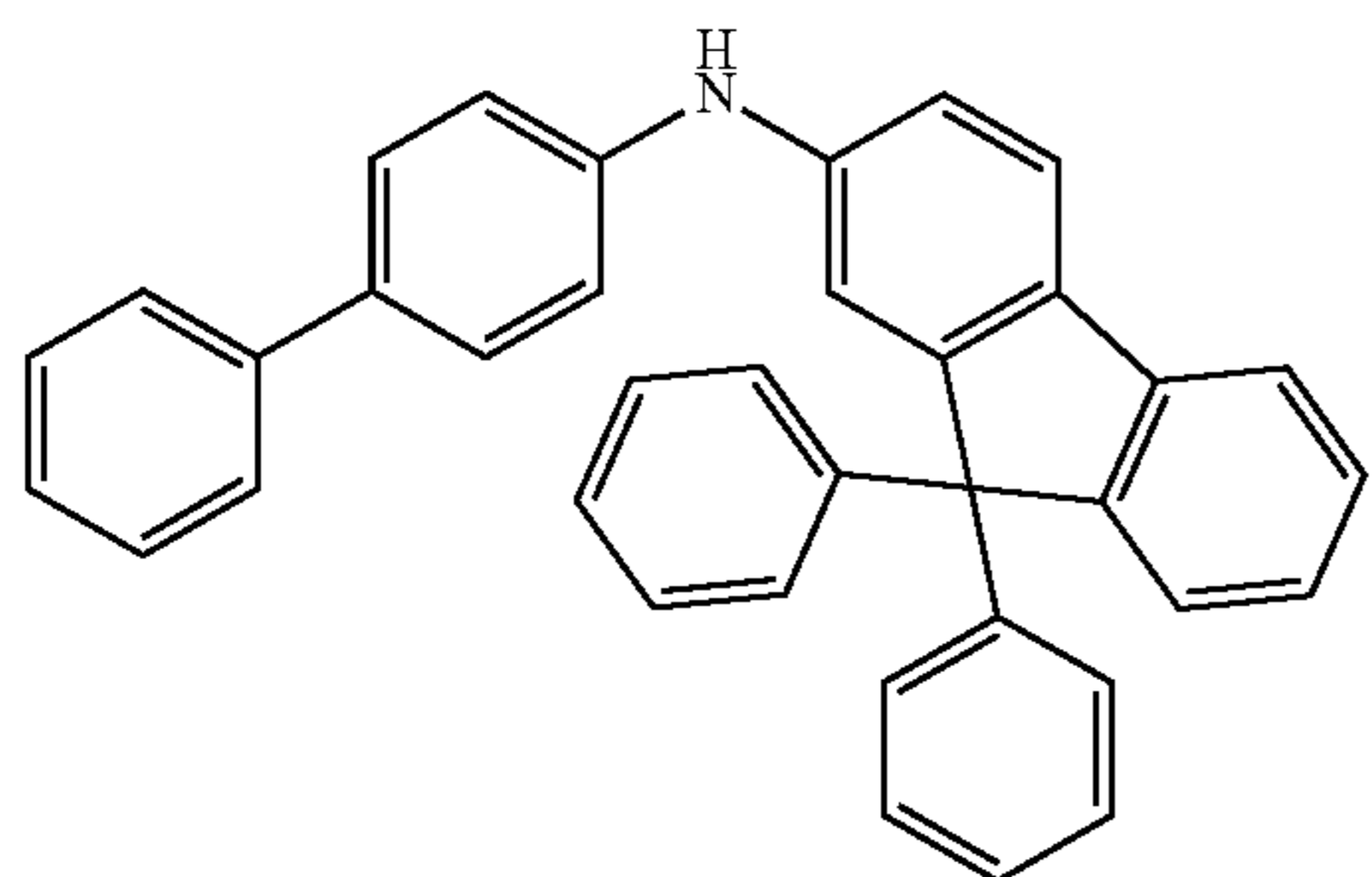
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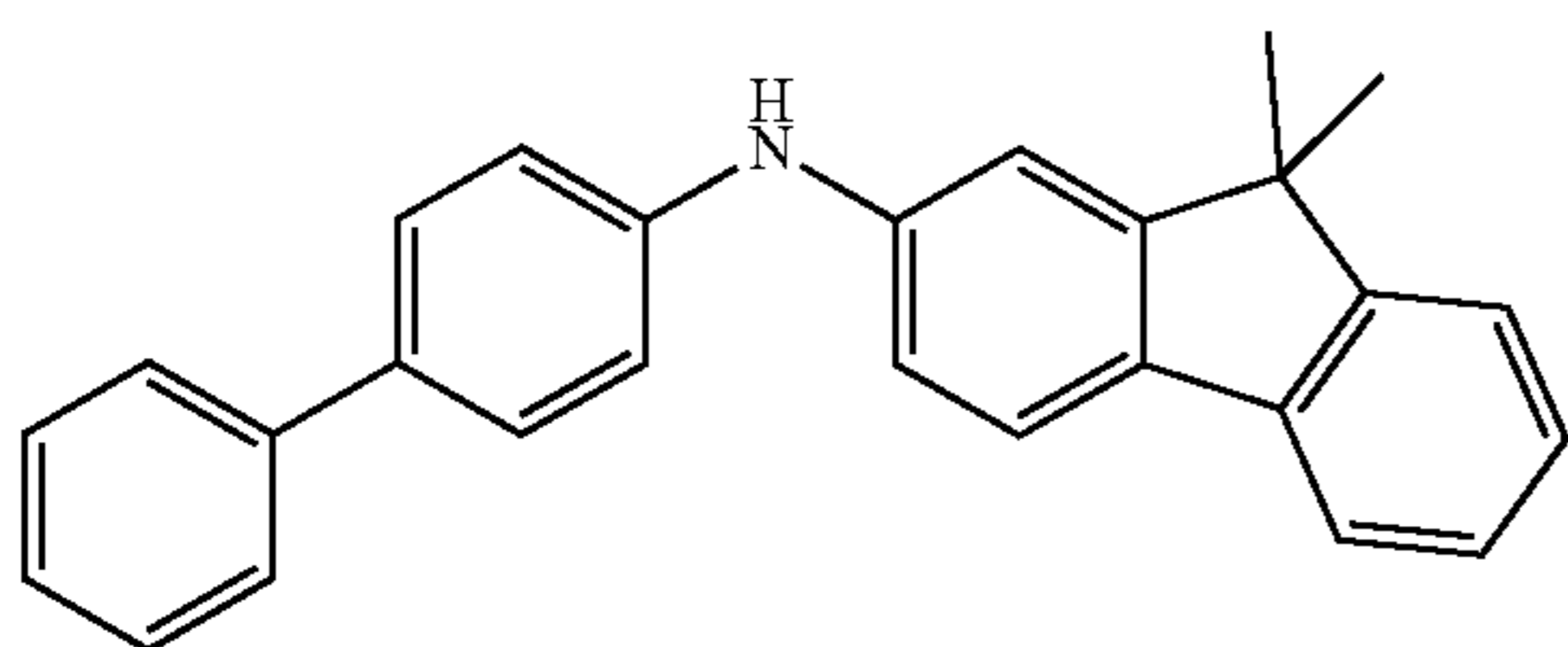
Sub 2-33

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Sub 2-34

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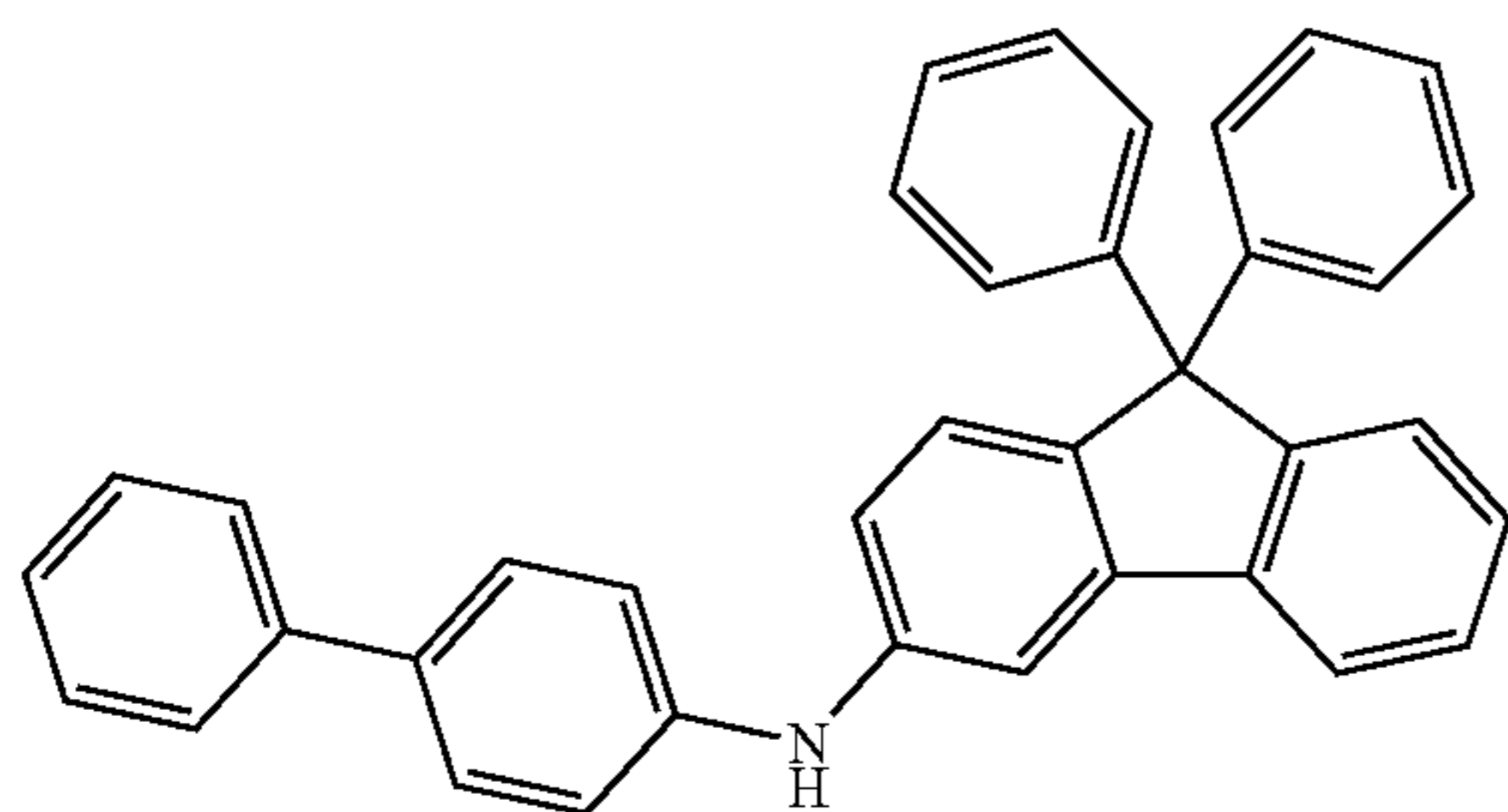


Sub 2-35

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Sub 2-36

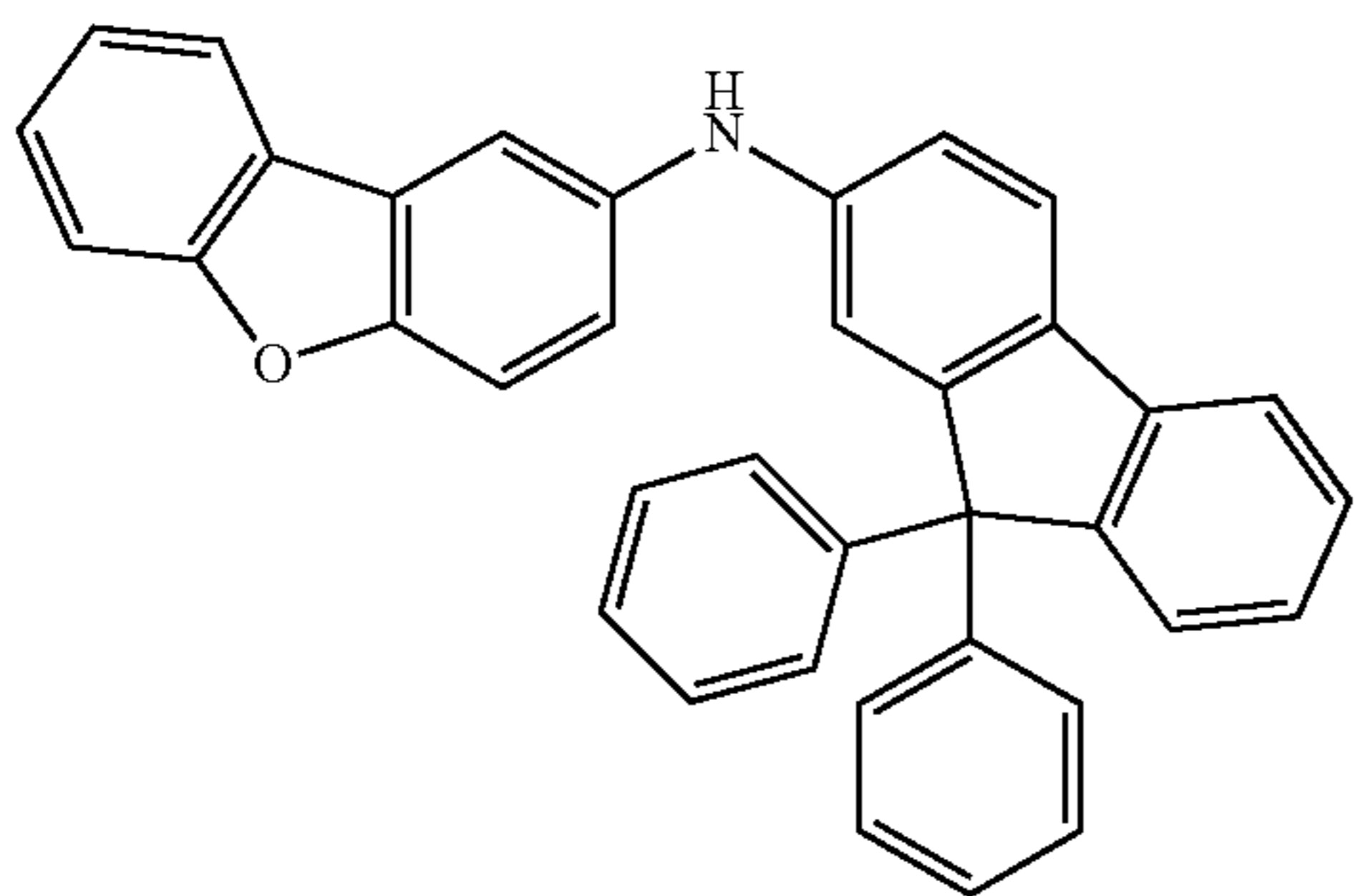
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Sub 2-37

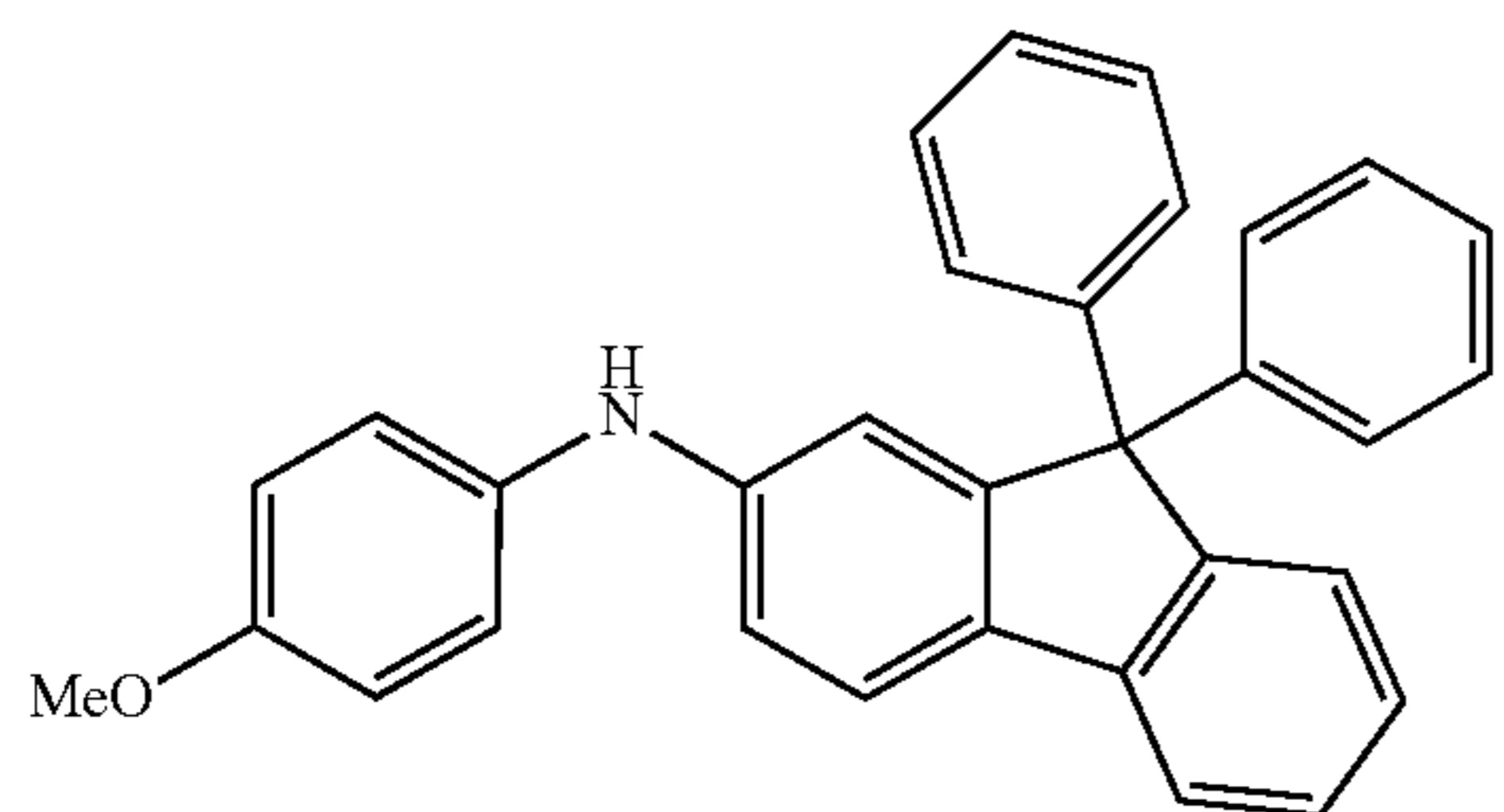
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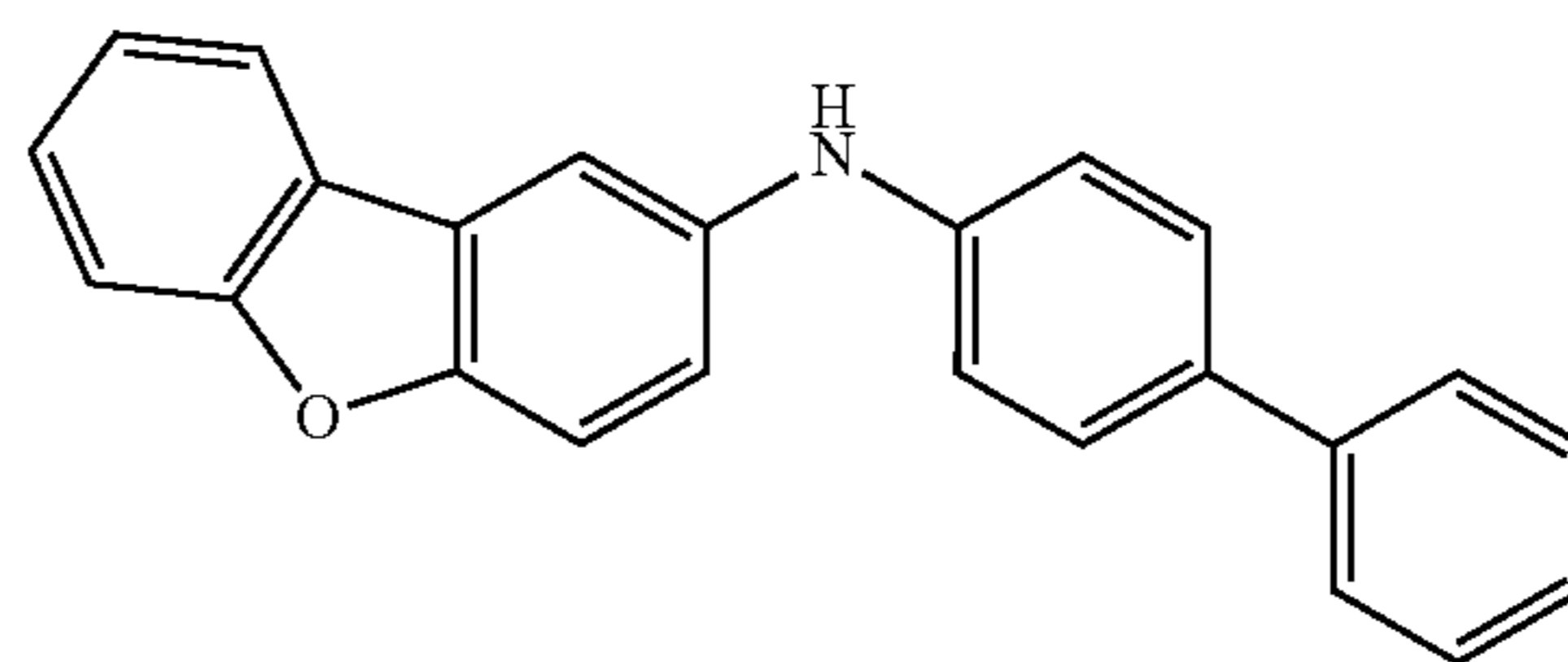
Sub 2-38

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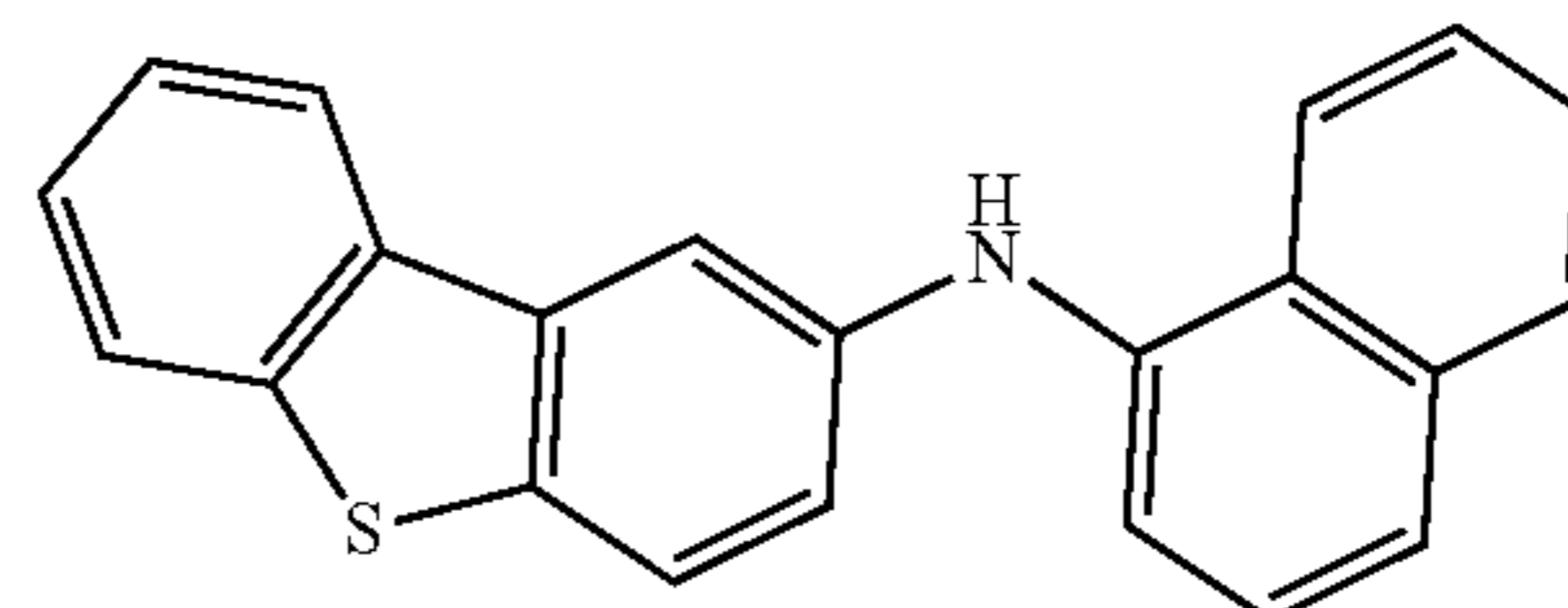
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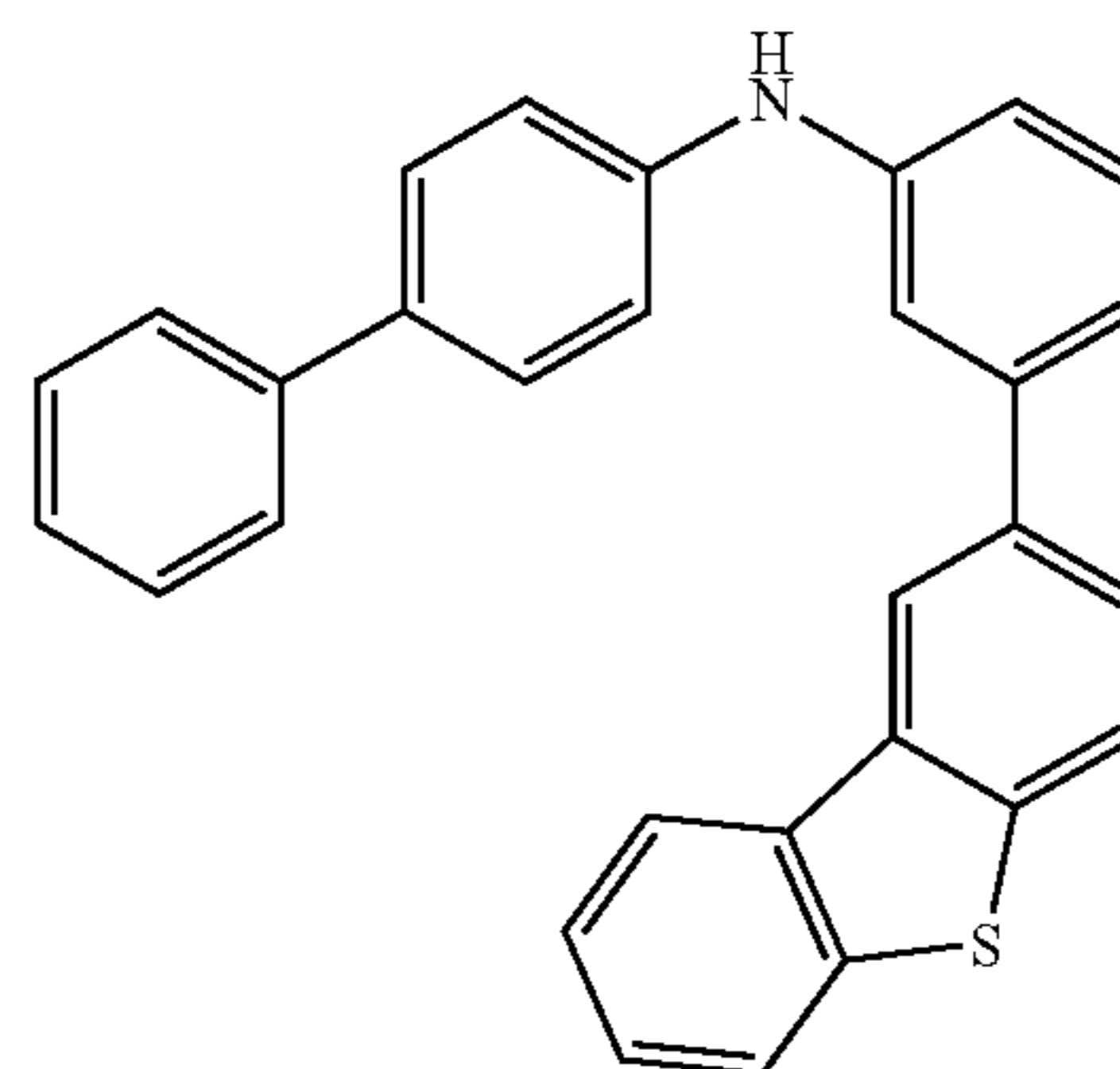
Sub 2-39

10



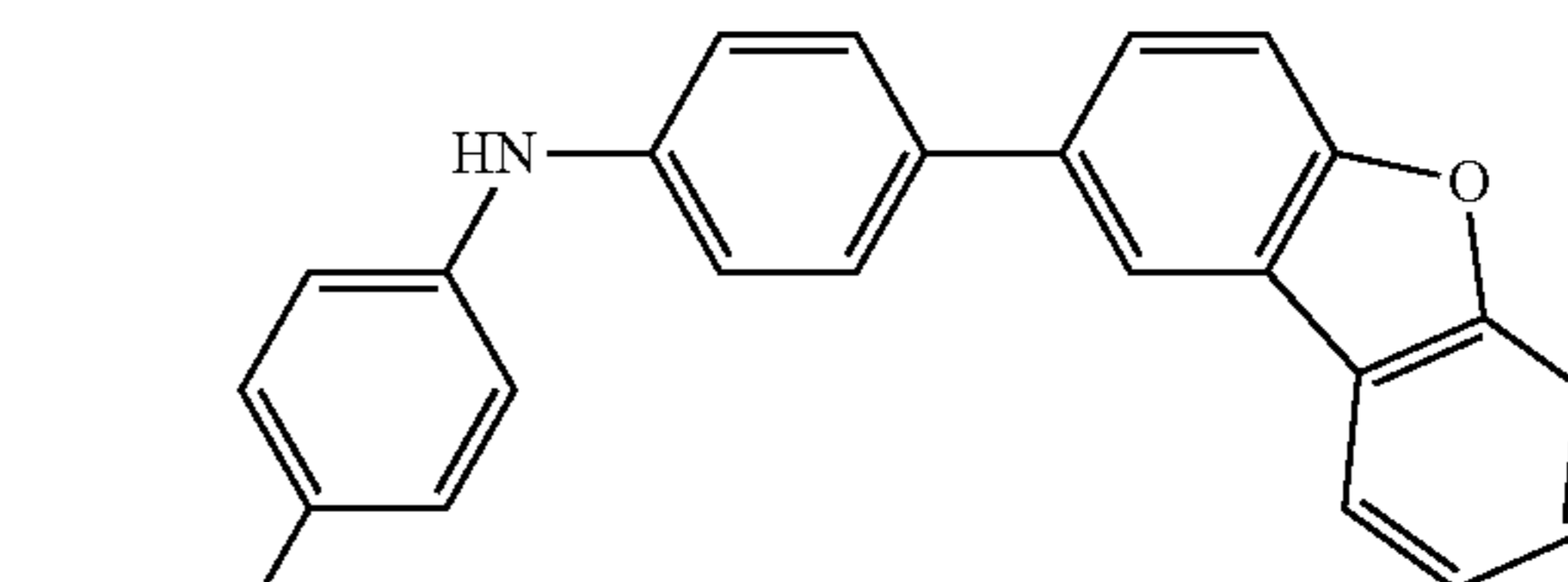
Sub 2-40

20



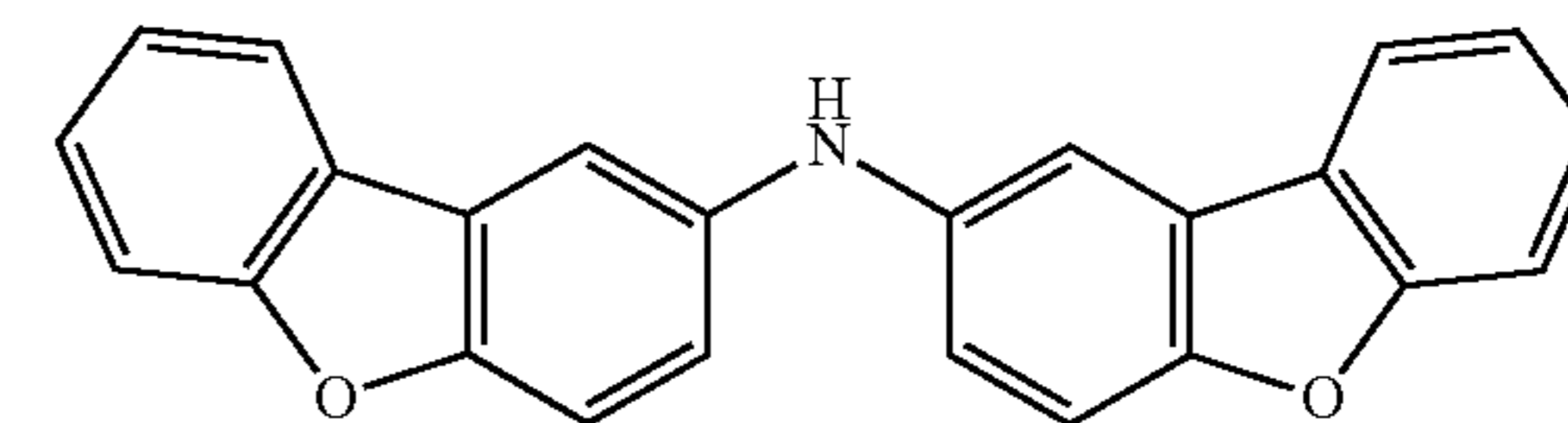
Sub 2-41

30



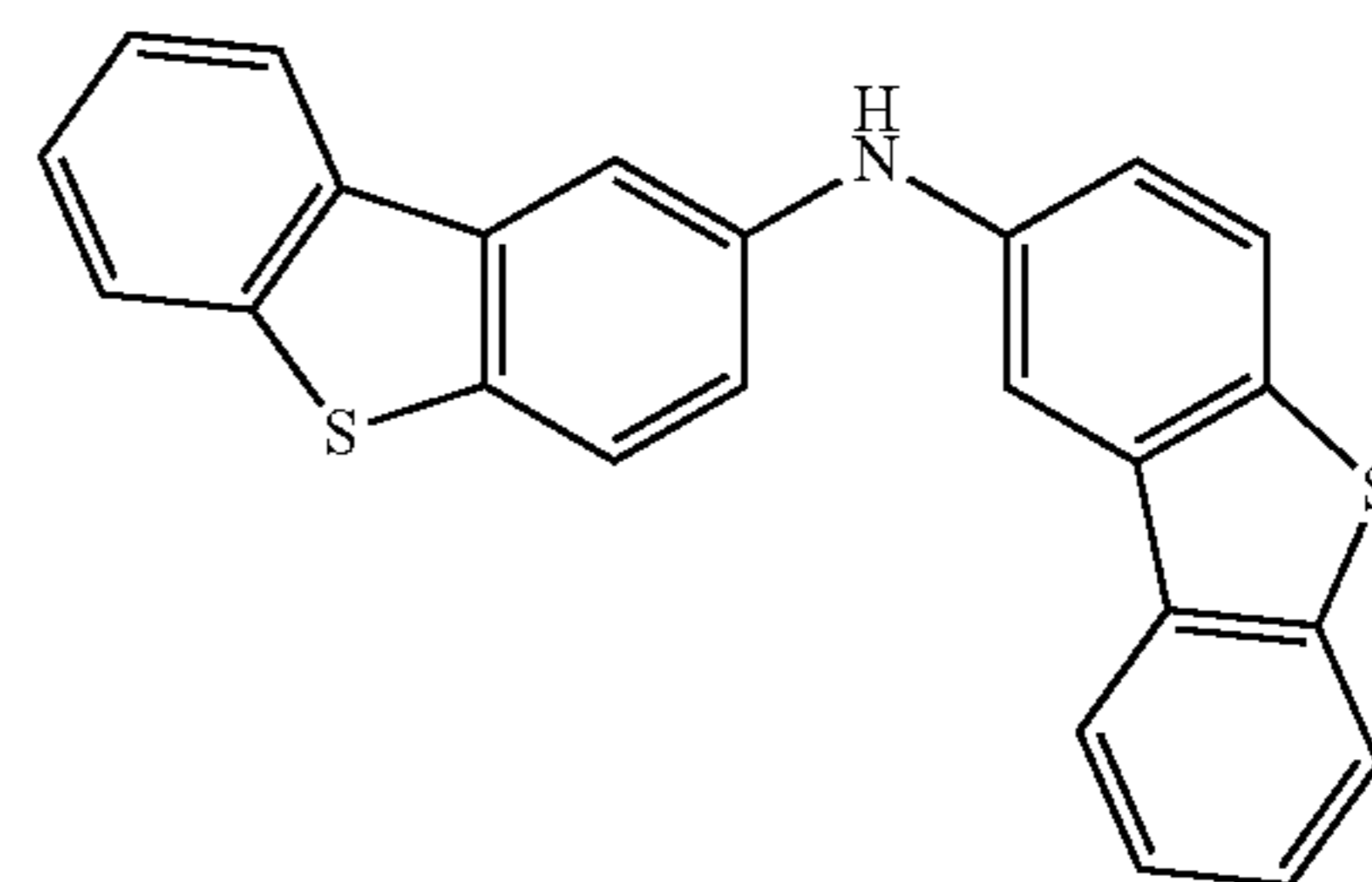
Sub 2-42

40



Sub 2-43

55

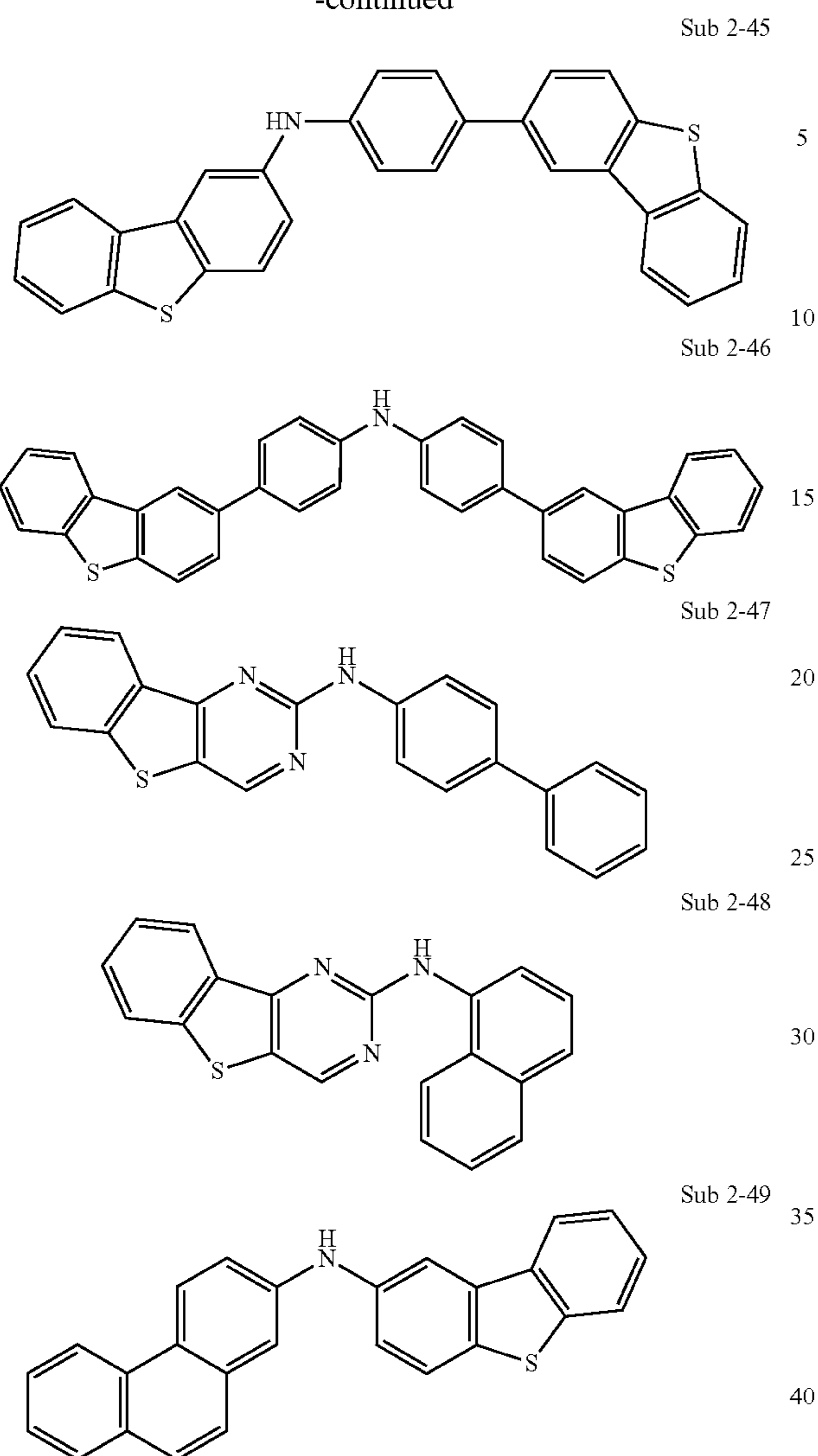


Sub 2-44

65

99

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100

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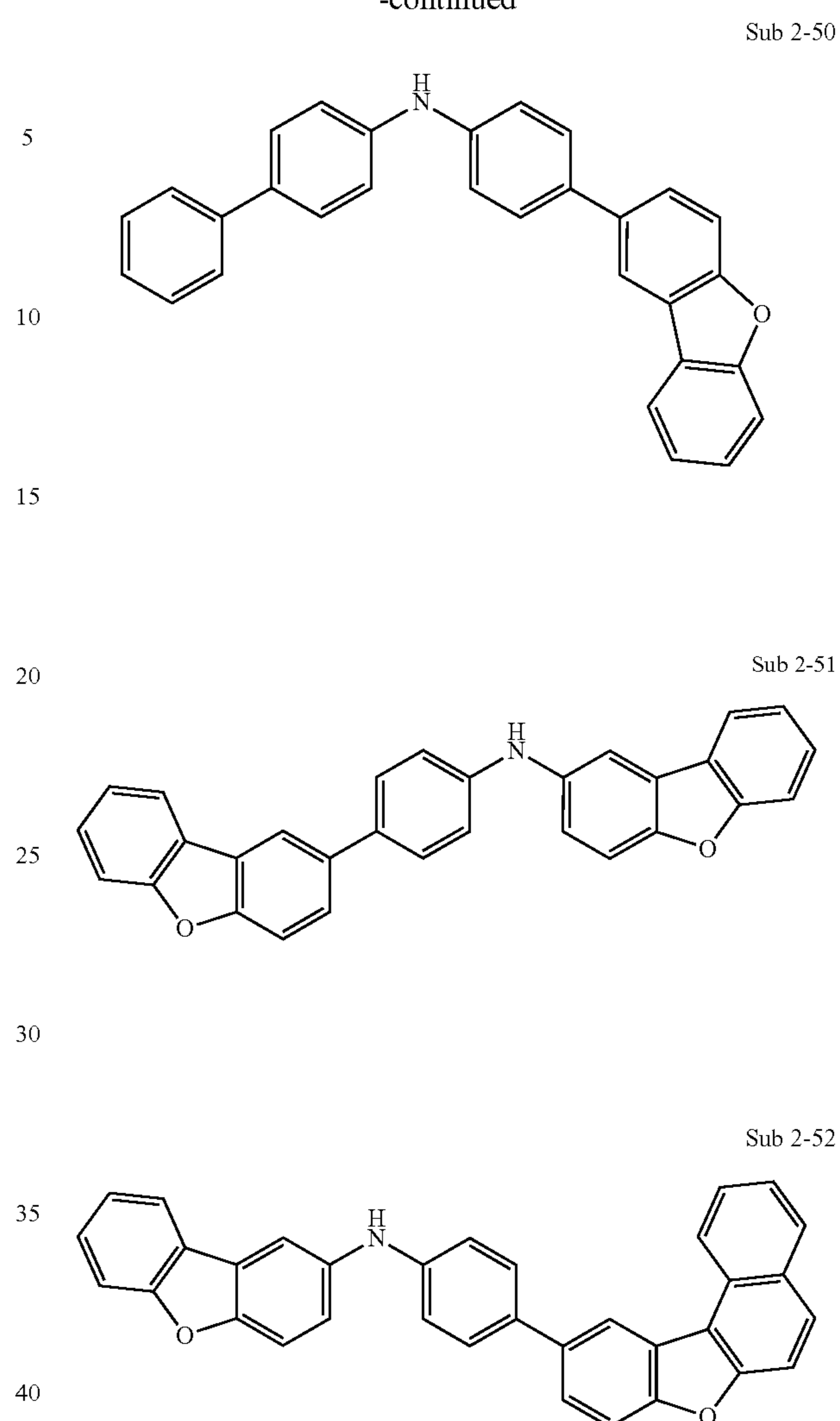


TABLE 1

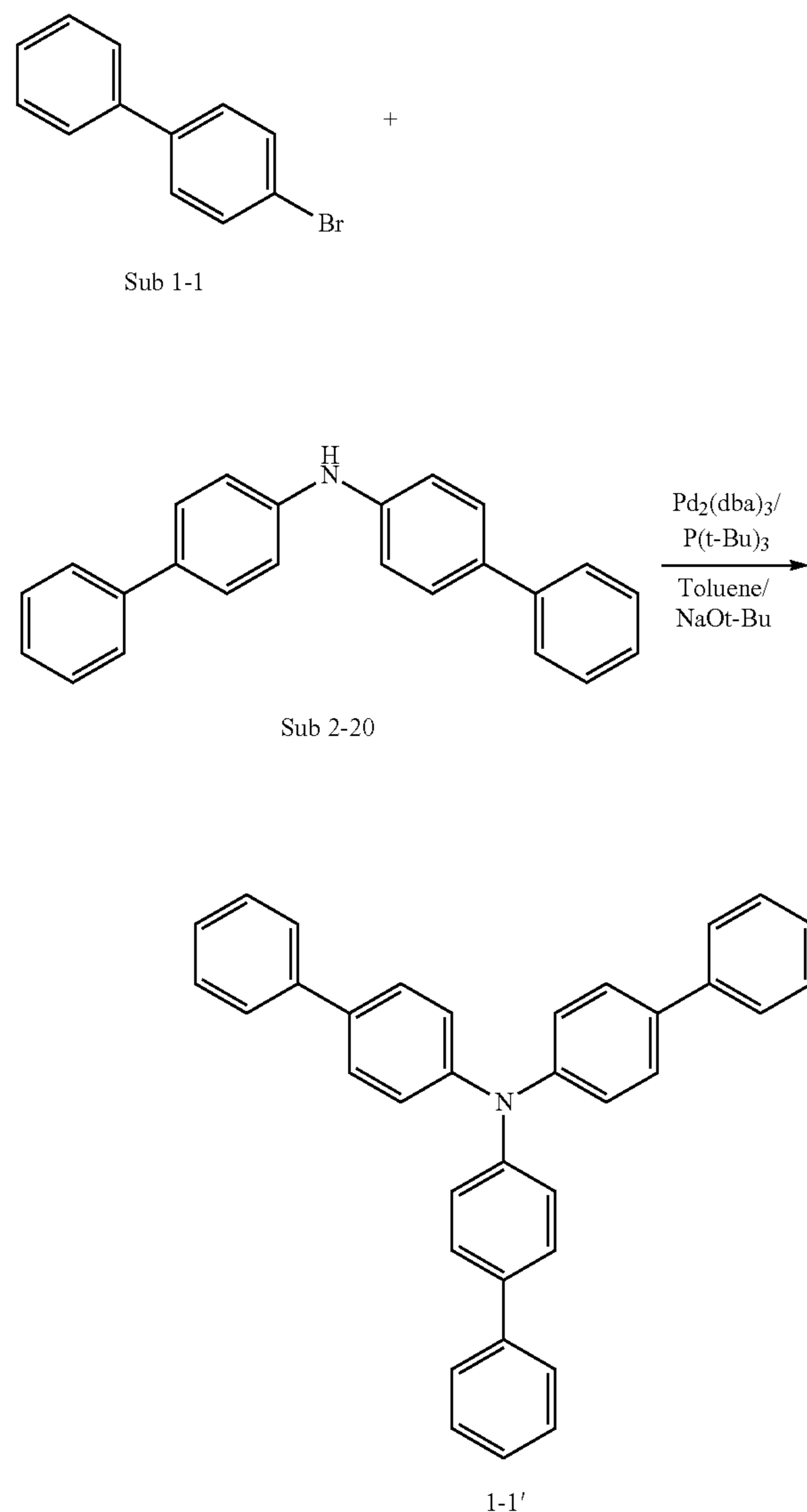
compound	FD-MS	compound	FD-MS
Sub 2-1	m/z = 219.10(C <sub>16</sub> H <sub>13</sub> N = 219.28)	Sub 2-2	m/z = 295.14(C <sub>22</sub> H <sub>17</sub> N = 295.38)
Sub 2-3	m/z = 269.12(C <sub>20</sub> H <sub>15</sub> N = 269.34)	Sub 2-4	m/z = 169.09(C <sub>12</sub> H <sub>11</sub> N = 169.22)
Sub 2-5	m/z = 245.12(C <sub>18</sub> H <sub>15</sub> N = 245.32)	Sub 2-6	m/z = 321.15(C <sub>24</sub> H <sub>19</sub> N = 321.41)
Sub 2-7	m/z = 269.12(C <sub>20</sub> H <sub>15</sub> N = 269.34)	Sub 2-8	m/z = 345.15(C <sub>26</sub> H <sub>19</sub> N = 345.44)
Sub 2-9	m/z = 345.15(C <sub>26</sub> H <sub>19</sub> N = 345.44)	Sub 2-10	m/z = 325.18(C <sub>24</sub> H <sub>23</sub> N = 325.45)
Sub 2-11	m/z = 397.18(C <sub>30</sub> H <sub>23</sub> N = 397.51)	Sub 2-12	m/z = 447.20(C <sub>34</sub> H <sub>25</sub> N = 447.57)
Sub 2-13	m/z = 371.17(C <sub>28</sub> H <sub>21</sub> N = 371.47)	Sub 2-14	m/z = 421.18(C <sub>32</sub> H <sub>23</sub> N = 421.53)
Sub 2-15	m/z = 295.14(C <sub>22</sub> H <sub>17</sub> N = 295.38)	Sub 2-16	m/z = 397.18(C <sub>30</sub> H <sub>23</sub> N = 397.51)
Sub 2-17	m/z = 321.15(C <sub>24</sub> H <sub>19</sub> N = 321.41)	Sub 2-18	m/z = 245.12(C <sub>18</sub> H <sub>15</sub> N = 245.32)
Sub 2-19	m/z = 321.15(C <sub>24</sub> H <sub>19</sub> N = 321.41)	Sub 2-20	m/z = 321.15(C <sub>24</sub> H <sub>19</sub> N = 321.41)
Sub 2-21	m/z = 371.17(C <sub>28</sub> H <sub>21</sub> N = 371.47)	Sub 2-22	m/z = 421.18(C <sub>32</sub> H <sub>23</sub> N = 421.53)
Sub 2-23	m/z = 395.17(C <sub>30</sub> H <sub>21</sub> N = 395.49)	Sub 2-24	m/z = 473.21(C <sub>36</sub> H <sub>27</sub> N = 473.61)
Sub 2-25	m/z = 369.15(C <sub>28</sub> H <sub>19</sub> N = 369.46)	Sub 2-26	m/z = 561.25(C <sub>43</sub> H <sub>31</sub> N = 561.71)
Sub 2-27	m/z = 411.20(C <sub>31</sub> H <sub>25</sub> N = 411.54)	Sub 2-28	m/z = 459.20(C <sub>35</sub> H <sub>25</sub> N = 459.58)
Sub 2-29	m/z = 483.20(C <sub>37</sub> H <sub>25</sub> N = 483.60)	Sub 2-30	m/z = 375.16(C <sub>27</sub> H <sub>21</sub> NO = 375.46)
Sub 2-31	m/z = 475.19(C <sub>35</sub> H <sub>25</sub> NO = 475.58)	Sub 2-32	m/z = 575.22(C <sub>43</sub> H <sub>29</sub> NO = 575.70)
Sub 2-33	m/z = 533.21(C <sub>41</sub> H <sub>27</sub> N = 533.66)	Sub 2-34	m/z = 485.21(C <sub>37</sub> H <sub>27</sub> N = 485.62)
Sub 2-35	m/z = 361.18(C <sub>27</sub> H <sub>23</sub> N = 361.48)	Sub 2-36	m/z = 485.21(C <sub>37</sub> H <sub>27</sub> N = 485.62)
Sub 2-37	m/z = 499.19(C <sub>37</sub> H <sub>25</sub> NO = 499.60)	Sub 2-38	m/z = 439.19(C <sub>32</sub> H <sub>25</sub> NO = 439.55)
Sub 2-39	m/z = 335.13(C <sub>24</sub> H <sub>17</sub> NO = 335.40)	Sub 2-40	m/z = 325.09(C <sub>22</sub> H <sub>15</sub> NS = 325.43)
Sub 2-41	m/z = 427.14(C <sub>30</sub> H <sub>21</sub> NS = 427.56)	Sub 2-42	m/z = 461.18(C <sub>34</sub> H <sub>23</sub> NO = 461.55)
Sub 2-43	m/z = 349.11(C <sub>24</sub> H <sub>15</sub> NO <sub>2</sub> = 349.38)	Sub 2-44	m/z = 381.06(C <sub>24</sub> H <sub>15</sub> NS <sub>2</sub> = 381.51)
Sub 2-45	m/z = 457.10(C <sub>30</sub> H <sub>19</sub> NS <sub>2</sub> = 457.61)	Sub 2-46	m/z = 533.13(C <sub>36</sub> H <sub>23</sub> NS <sub>2</sub> = 533.70)
Sub 2-47	m/z = 353.10(C <sub>22</sub> H <sub>15</sub> N <sub>3</sub> S = 353.44)	Sub 2-48	m/z = 327.0(C <sub>20</sub> H <sub>13</sub> N <sub>3</sub> S = 327.40)

TABLE 1-continued

compound	FD-MS	compound	FD-MS
Sub 2-49	m/z = 375.11(C <sub>26</sub> H <sub>17</sub> NS = 375.48)	Sub 2-50	m/z = 411.16(C <sub>30</sub> H <sub>21</sub> NO = 411.49)
Sub 2-51	m/z = 425.14(C <sub>30</sub> H <sub>19</sub> NO <sub>2</sub> = 425.48)	Sub 2-52	m/z = 475.16(C <sub>34</sub> H <sub>21</sub> NO <sub>2</sub> = 475.54)

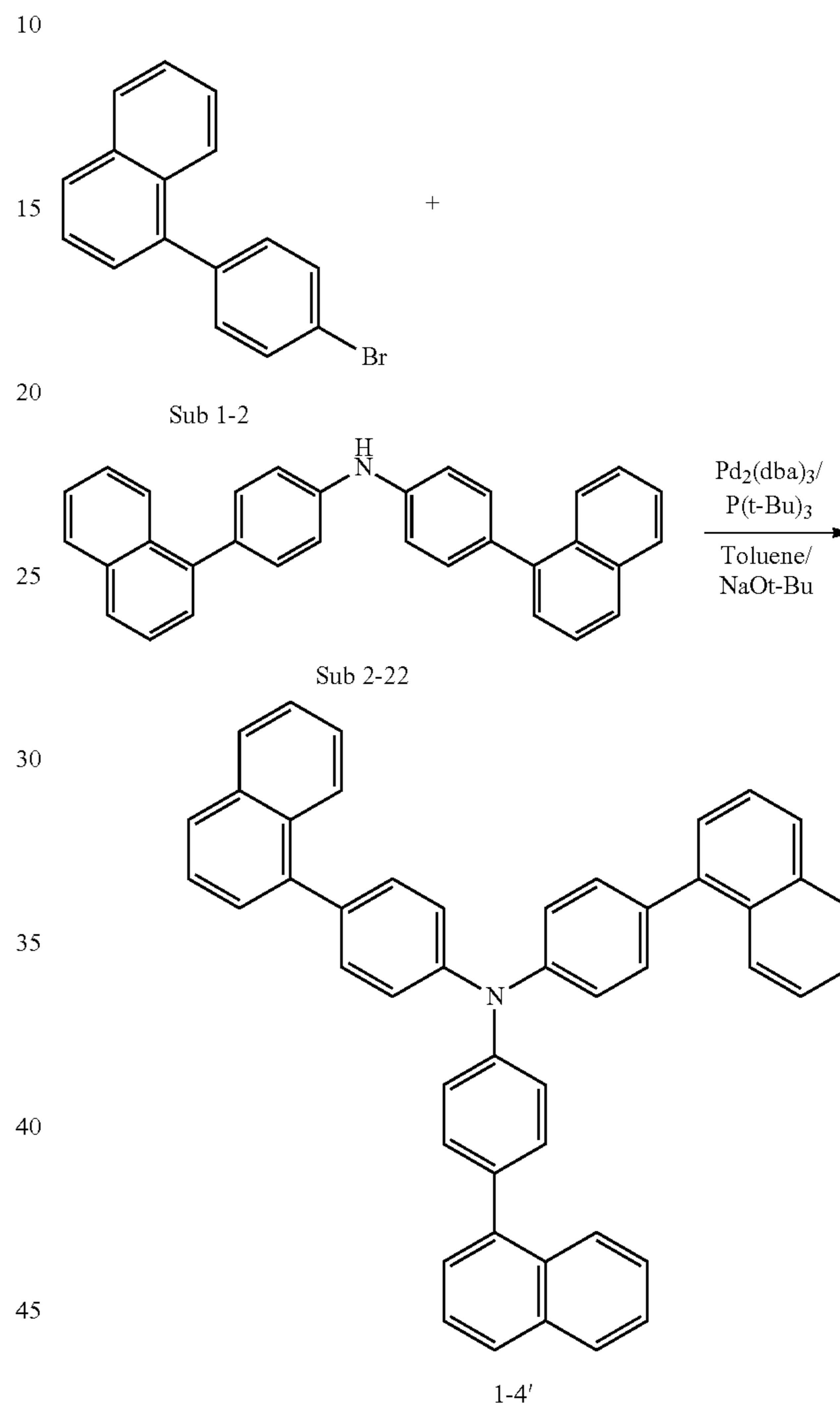
## Synthesis Examples of Final Product

## Synthesis 1-1'



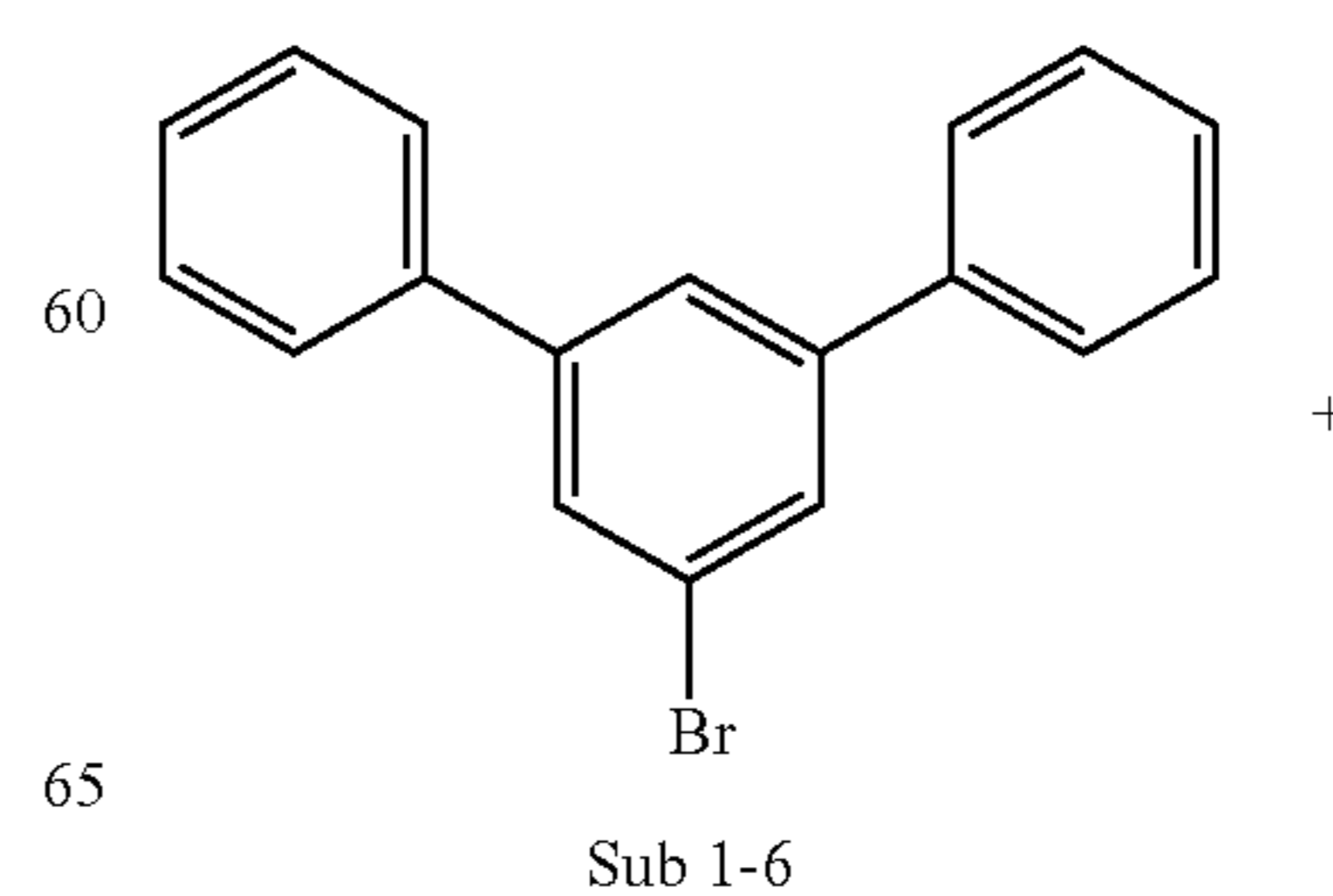
In a round bottom flask, di([1,1'-biphenyl]-4-yl)amine (10 g, 31.1 mmol), 4-bromo-1,1'-biphenyl (8 g, 34.2 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.42 g, 1.56 mmol), P(t-Bu)<sub>3</sub> (0.63 g, 3.11 mmol), NaOt-Bu (9.87 g, 102.7 mmol), toluene (330 mL) were added, and stirred at 100° C. After the reaction was completed, the reaction mixture was extracted with CH<sub>2</sub>Cl<sub>2</sub> and water. The organic layer was dried over MgSO<sub>4</sub> and concentrated. The resulting compound was separated by silica-gel column chromatography and recrystallized to obtain 11.3 g of Product 1-1'. (Yield: 77%)

## Synthesis 1-4'



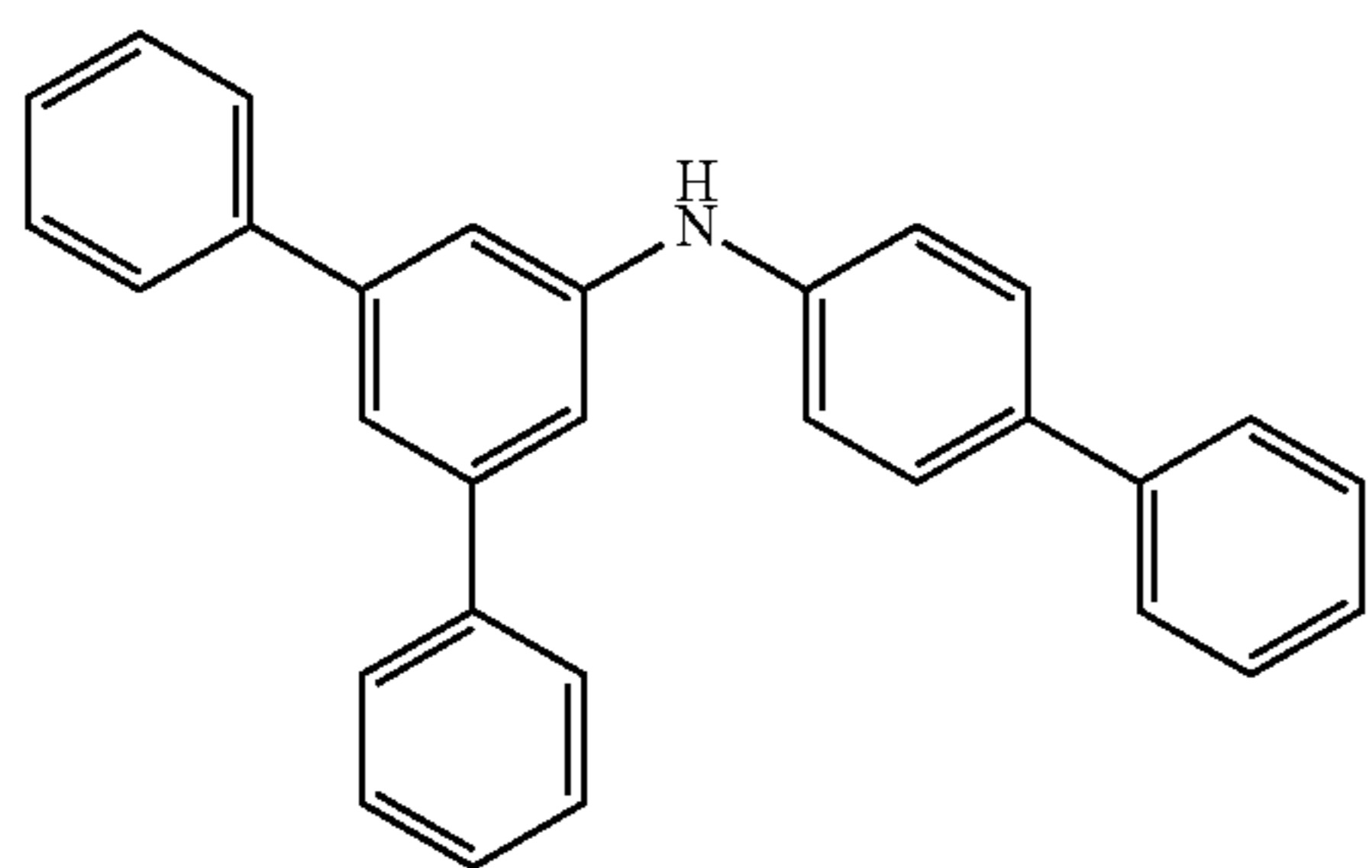
In a round bottom flask, bis(4-(naphthalen-1-yl)phenyl)amine (10 g, 23.7 mmol), 1-(4-bromophenyl)naphthalene (7.4 g, 26.1 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.09 g, 1.19 mmol), P(t-Bu)<sub>3</sub> (0.5 g, 2.4 mmol), NaOt-Bu (7.52 g, 78.3 mmol), toluene (250 mL) were tested in the same manner as in the above 1-1' to obtain 11.5 g of Product 1-4'. (Yield: 78%).

## Synthesis 1-10'

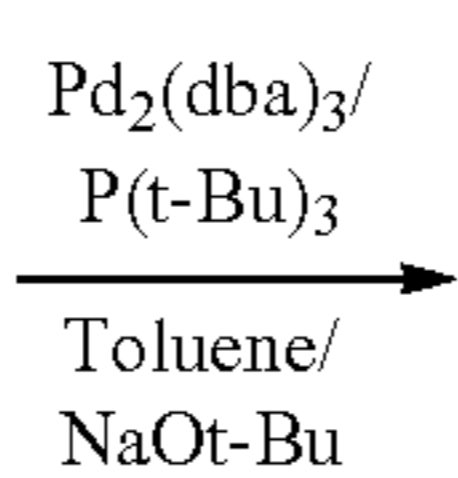


**103**

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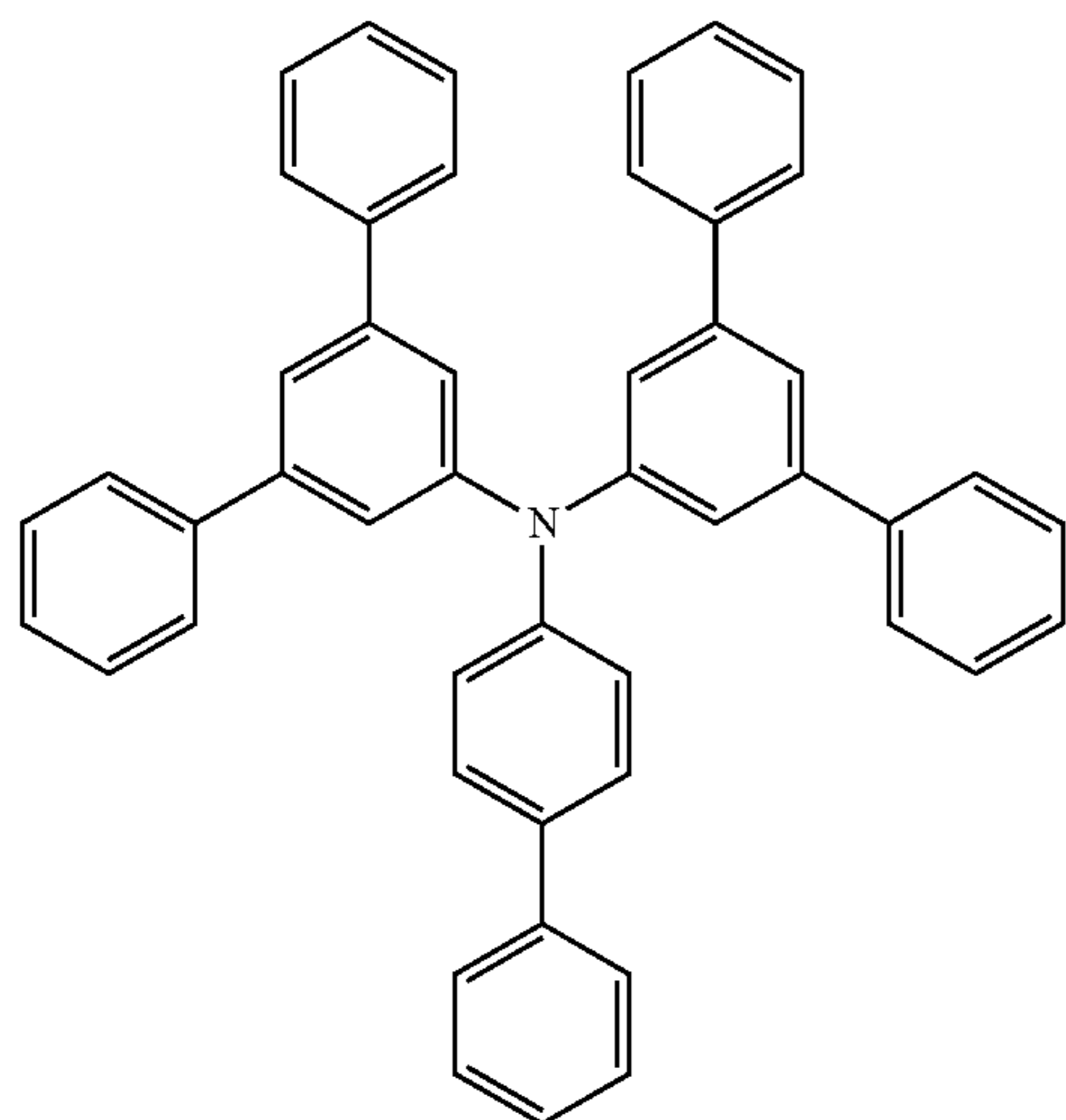
Sub 2-11



5

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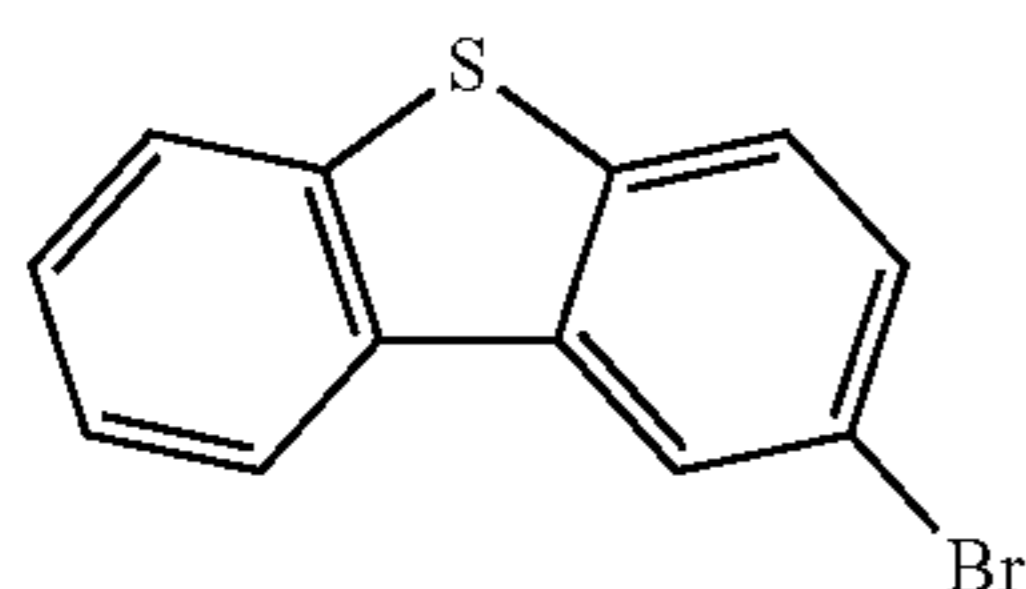
15



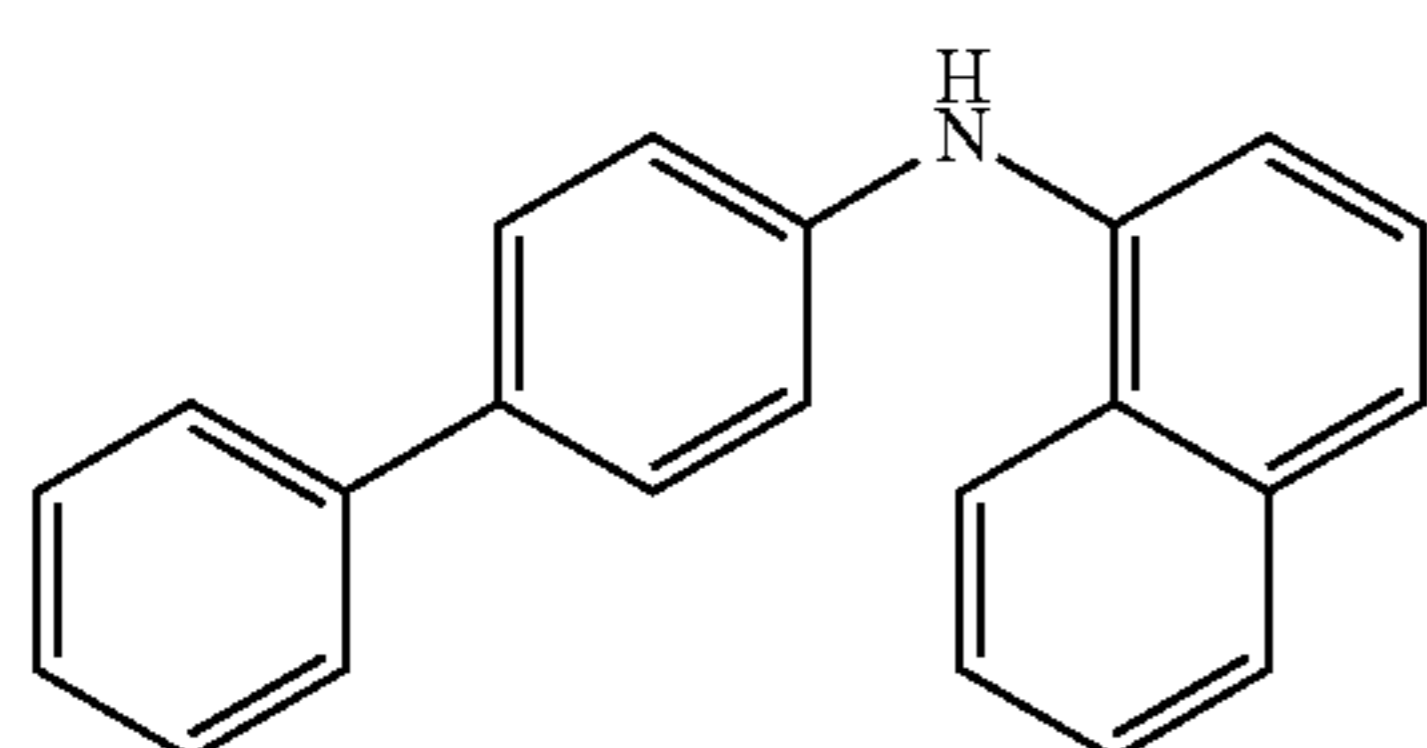
1-10'

In a round bottom flask, N-([1,1'-biphenyl]-4-yl)-[1,1':3',1''-terphenyl]-5'-amine (10 g, 25.2 mmol), 5'-bromo-1,1':3',1''-terphenyl (8.56 g, 27.7 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.15 g, 1.26 mmol), P(t-Bu)<sub>3</sub> (0.51 g, 2.52 mmol), NaOt-Bu (7.98 g, 83.02 mmol), toluene (264 mL) were tested in the same manner as in the above 1-1' to obtain 11.8 g of Product 1-10'. (Yield: 75%).

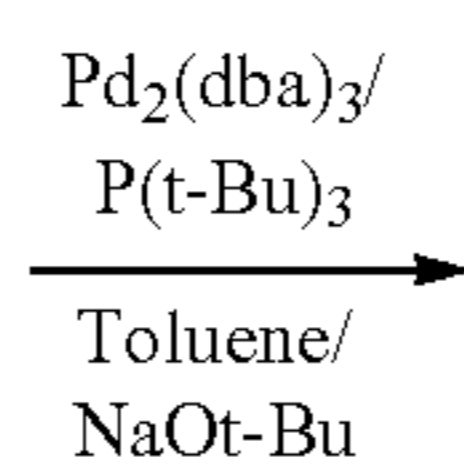
Synthesis 1-19'



Sub 1-10



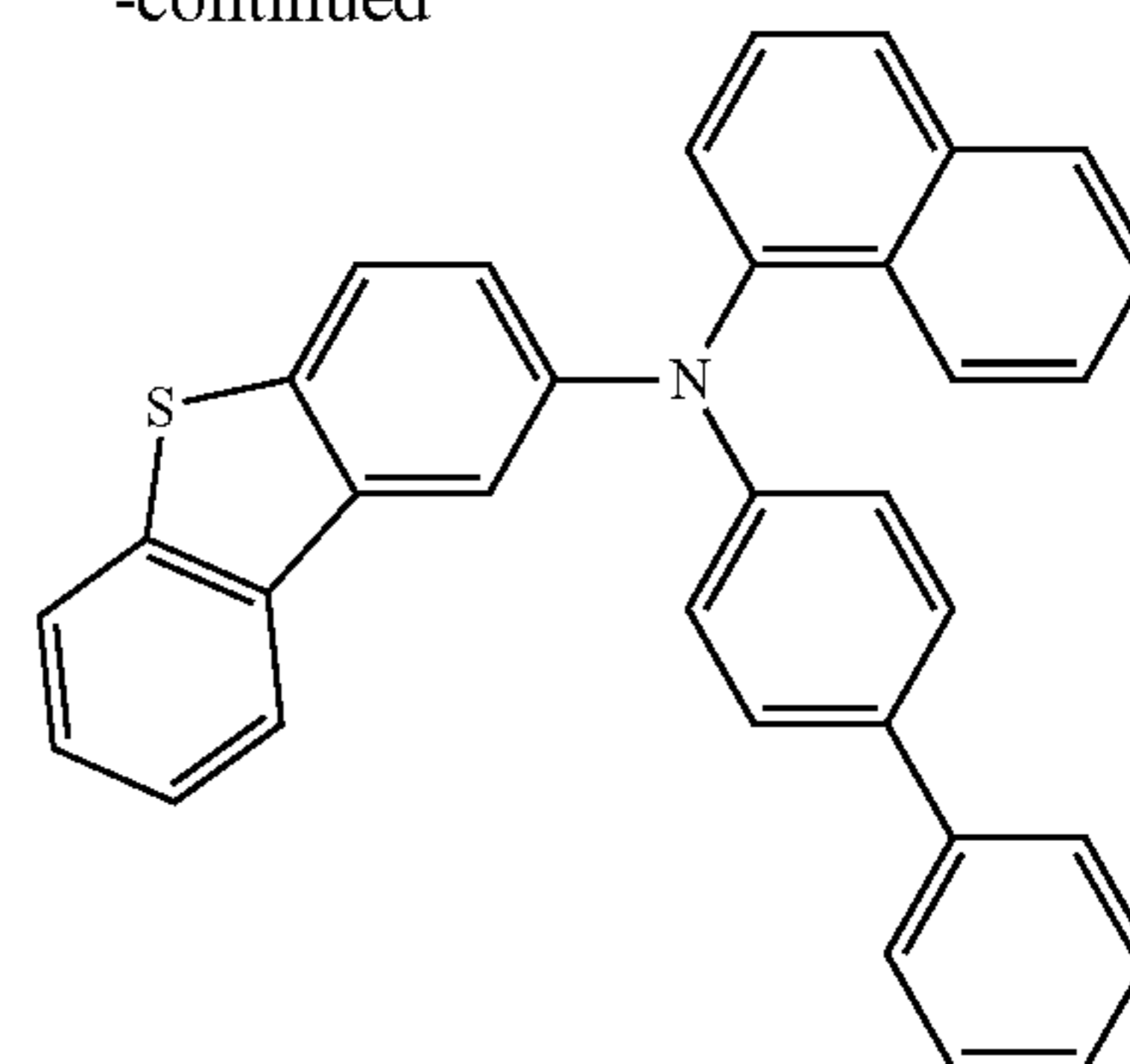
Sub 2-15



60

**104**

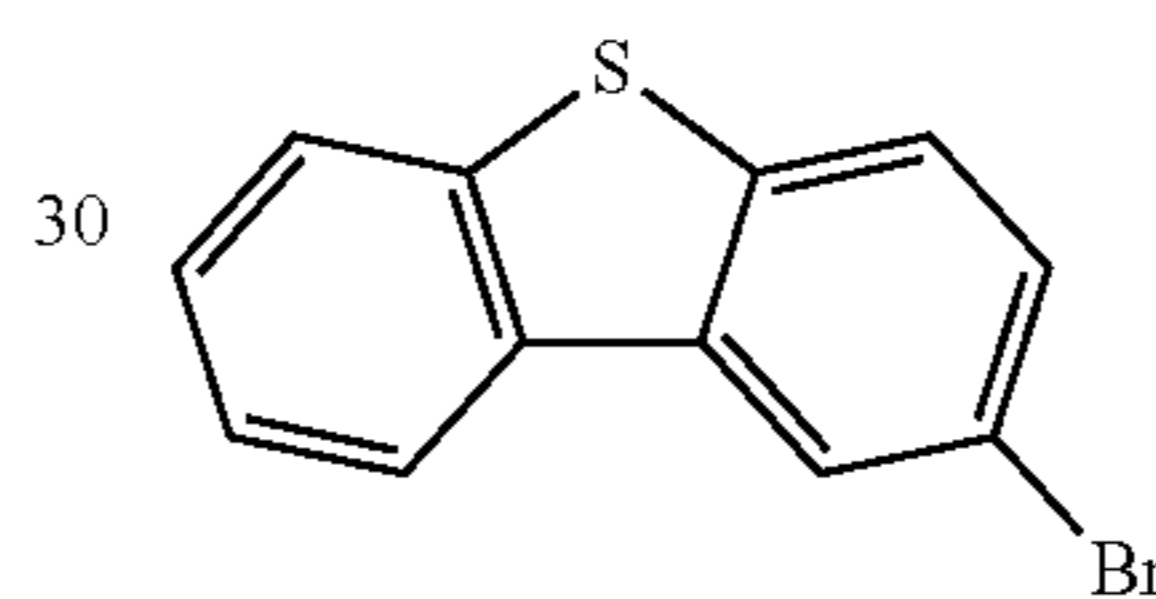
-continued



1-19'

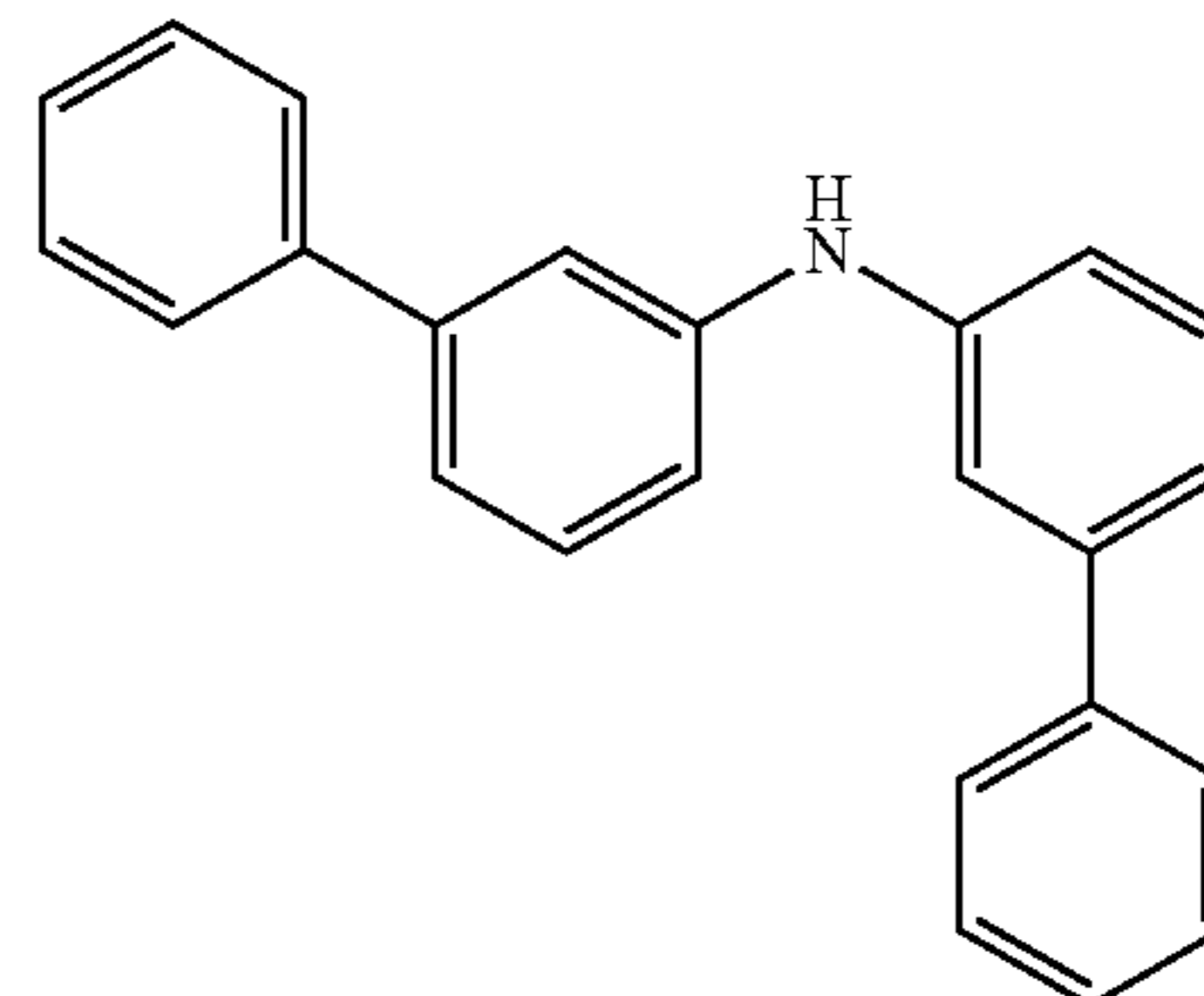
In a round bottom flask, N-([1,1'-biphenyl]-4-yl)naphthalen-1-amine (10 g, 33.6 mmol), 2-bromodibenzo[b,d]thiophene (9.8 g, 37.2 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.55 g, 1.7 mmol), P(t-Bu)<sub>3</sub> (0.68 g, 3.38 mmol), NaOt-Bu (10.76 g, 112 mmol), toluene (355 mL) were tested in the same manner as in the above 1-1' to obtain 12.3 g of Product 1-19'. (Yield: 76%).

Synthesis 1-20'



30

Sub 1-10

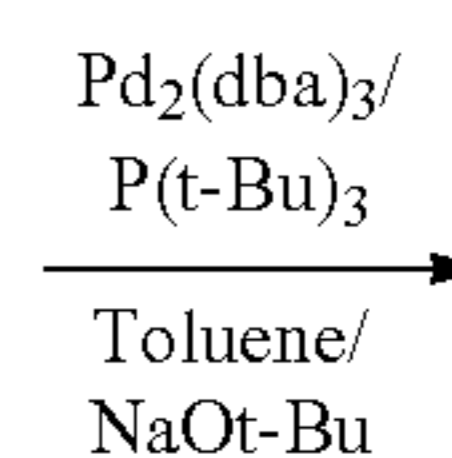


35

40

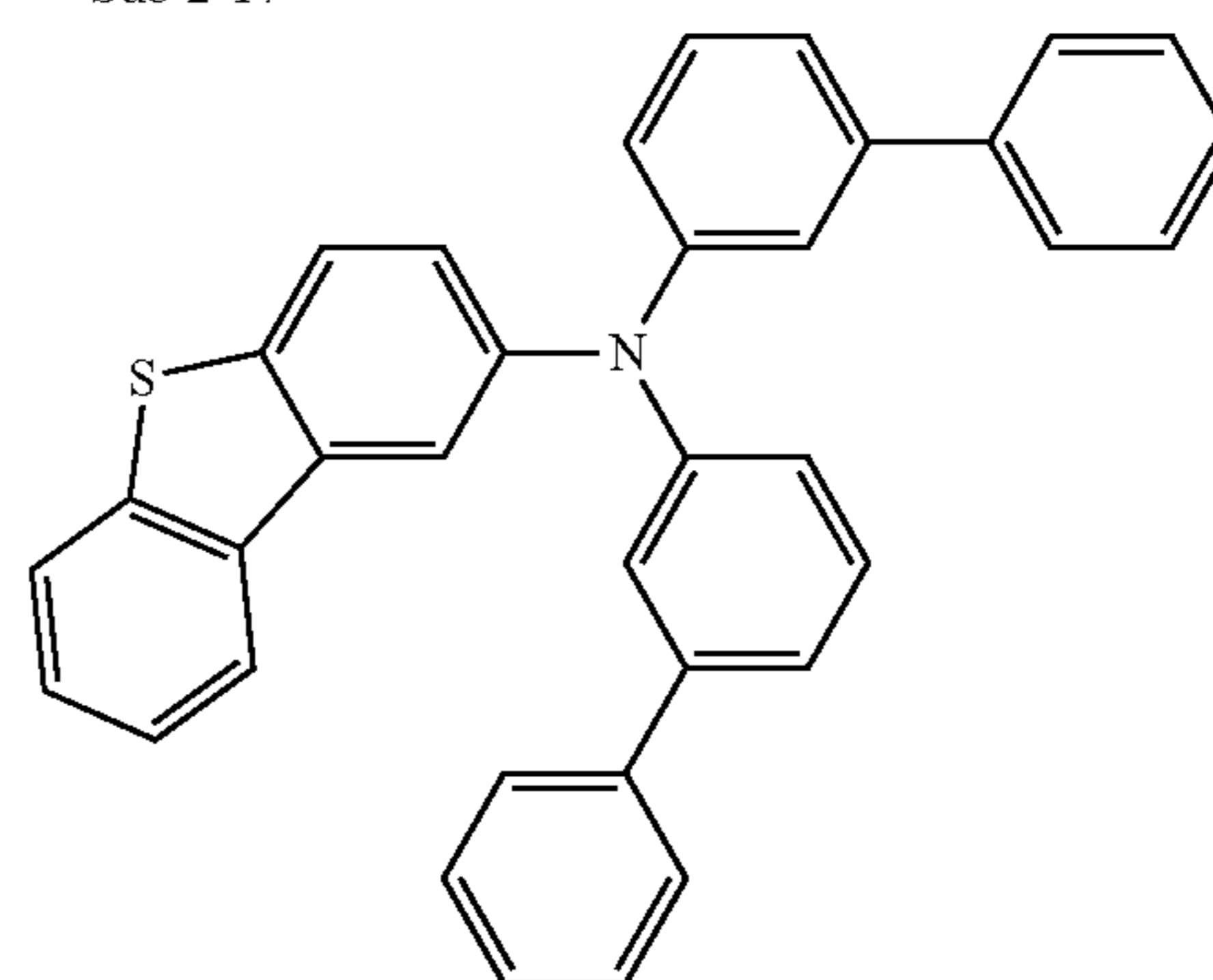
45

Sub 2-17



50

55



1-20'

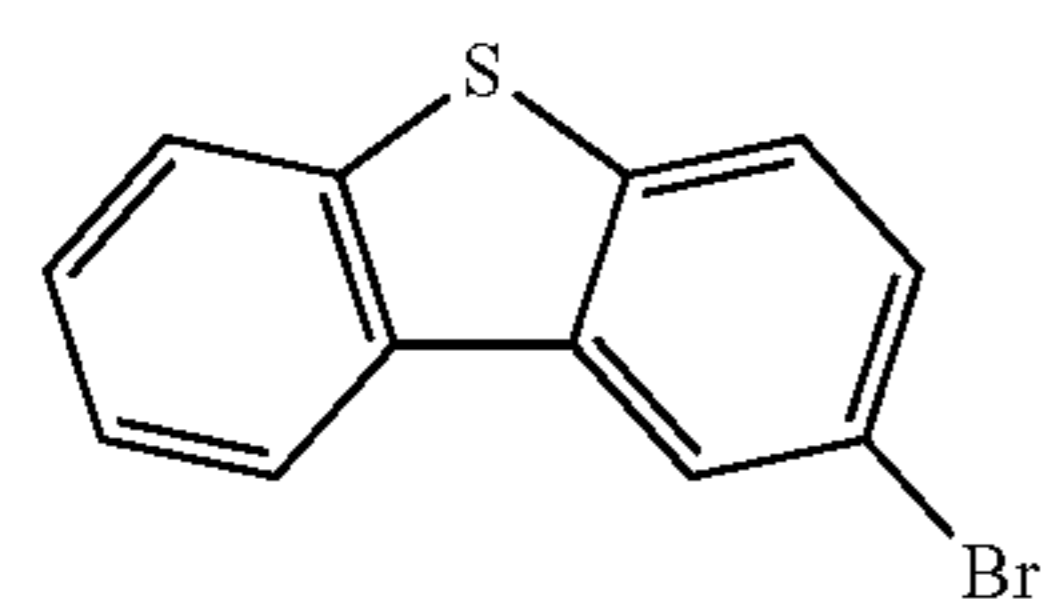
In a round bottom flask, di([1,1'-biphenyl]-3-yl)amine (10 g, 31.1 mmol), 2-bromodibenzo[b,d]thiophene (9 g, 34.2 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.42 g, 1.56 mmol), P(t-Bu)<sub>3</sub> (0.63 g, 3.11 mmol), NaOt-Bu (9.87 g, 102.7 mmol), toluene (327 mL)

65

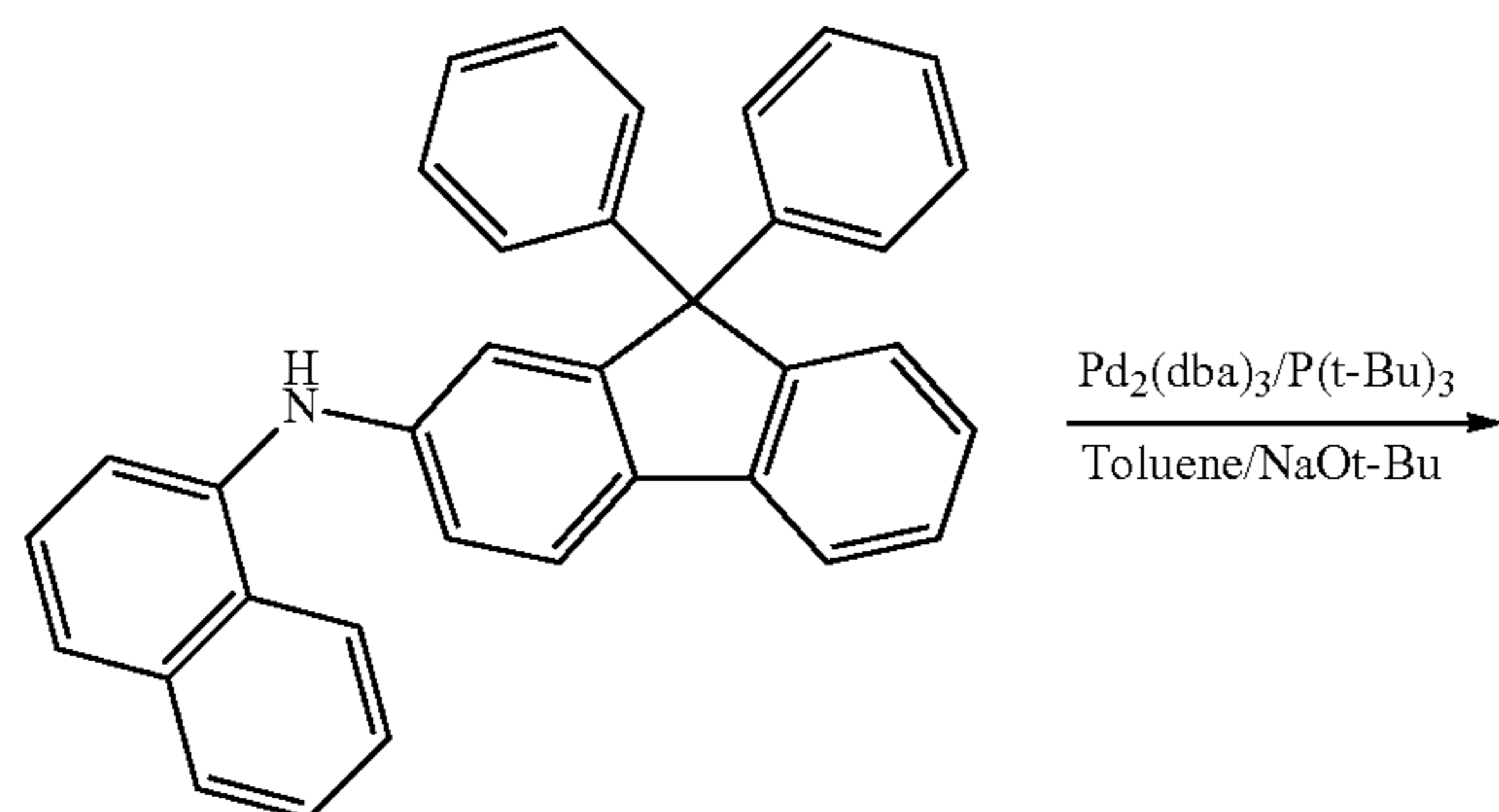
**105**

were tested in the same manner as in the above 1-1' to obtain 12.2 g of Product 1-20'. (Yield: 78%).

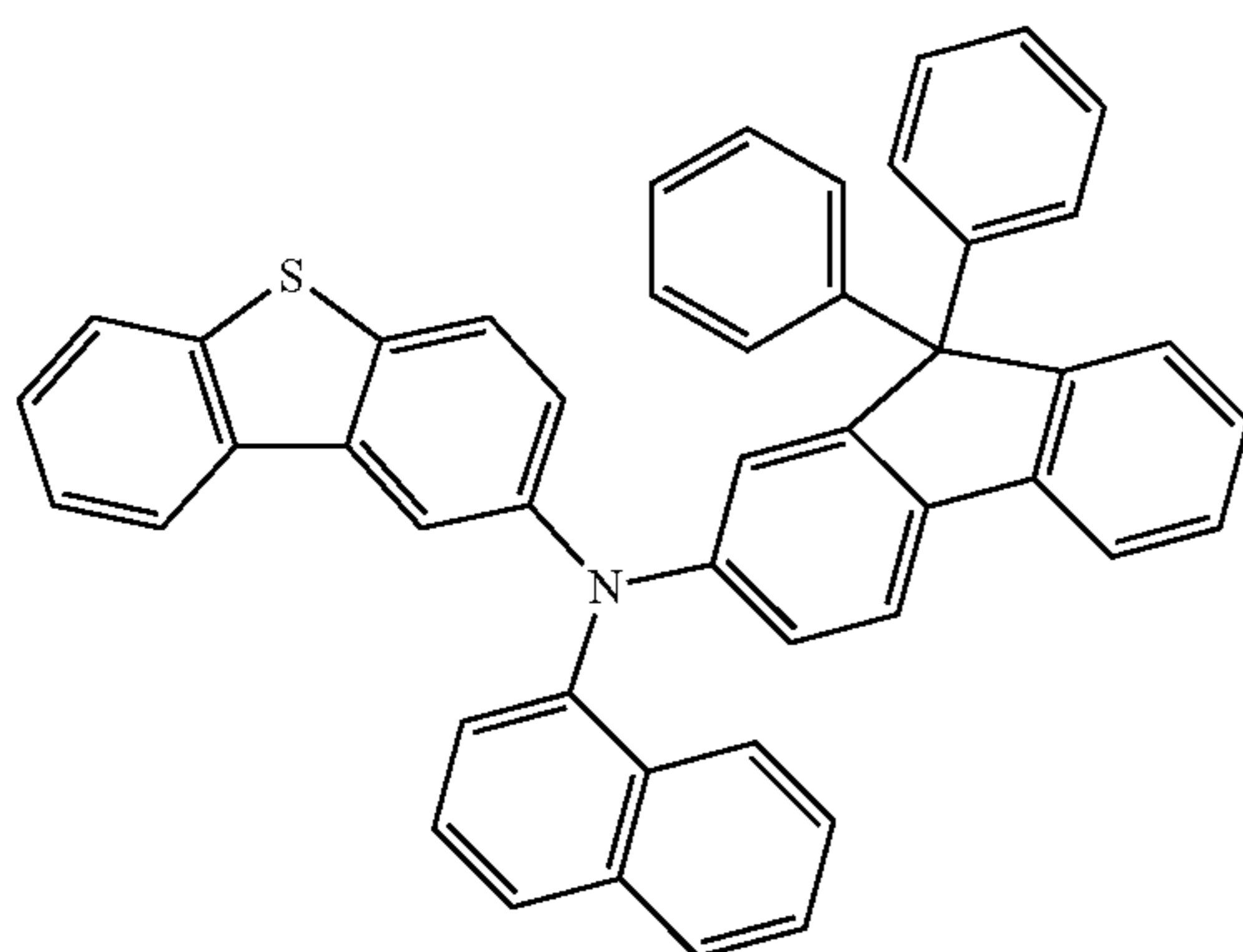
## Synthesis 1-23'



Sub 1-10



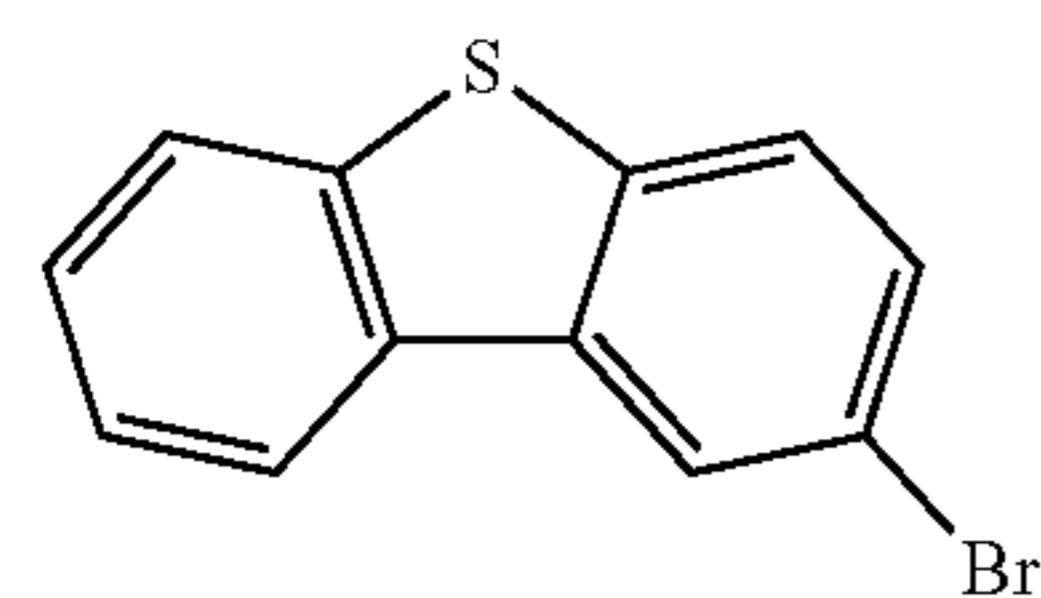
Sub 2-28



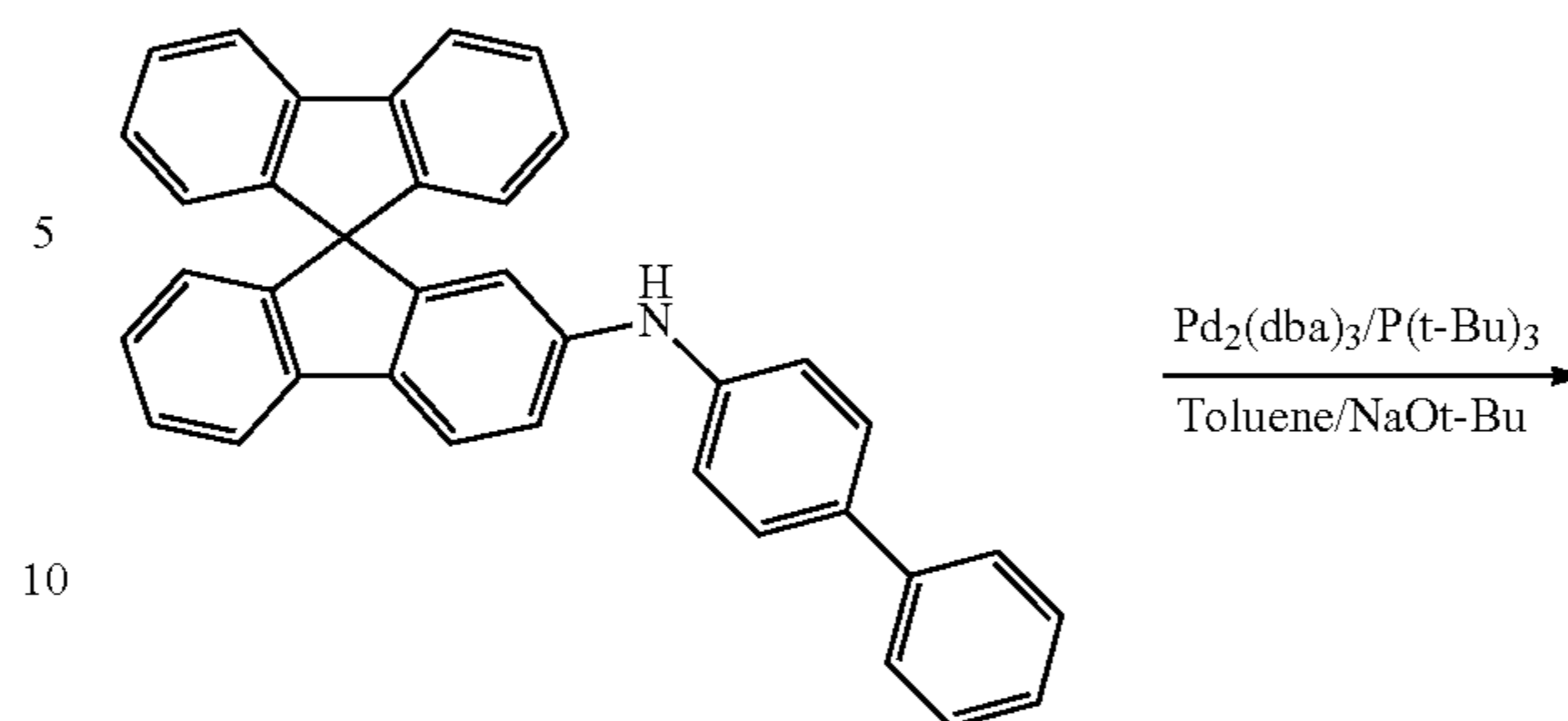
1-23'

In a round bottom flask, N-(naphthalen-1-yl)-9,9-diphenyl-9H-fluoren-2-amine (10 g, 21.8 mmol), 2-bromodibenzo[b,d]thiophene (6.3 g, 23.9 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1 g, 1.09 mmol), P(t-Bu)<sub>3</sub> (0.44 g, 2.2 mmol), NaOt-Bu (6.9 g, 71.8 mmol), toluene (230 mL) were tested in the same manner as in the above 1-1' to obtain 10.2 g of Product 1-23'. (Yield: 73%).

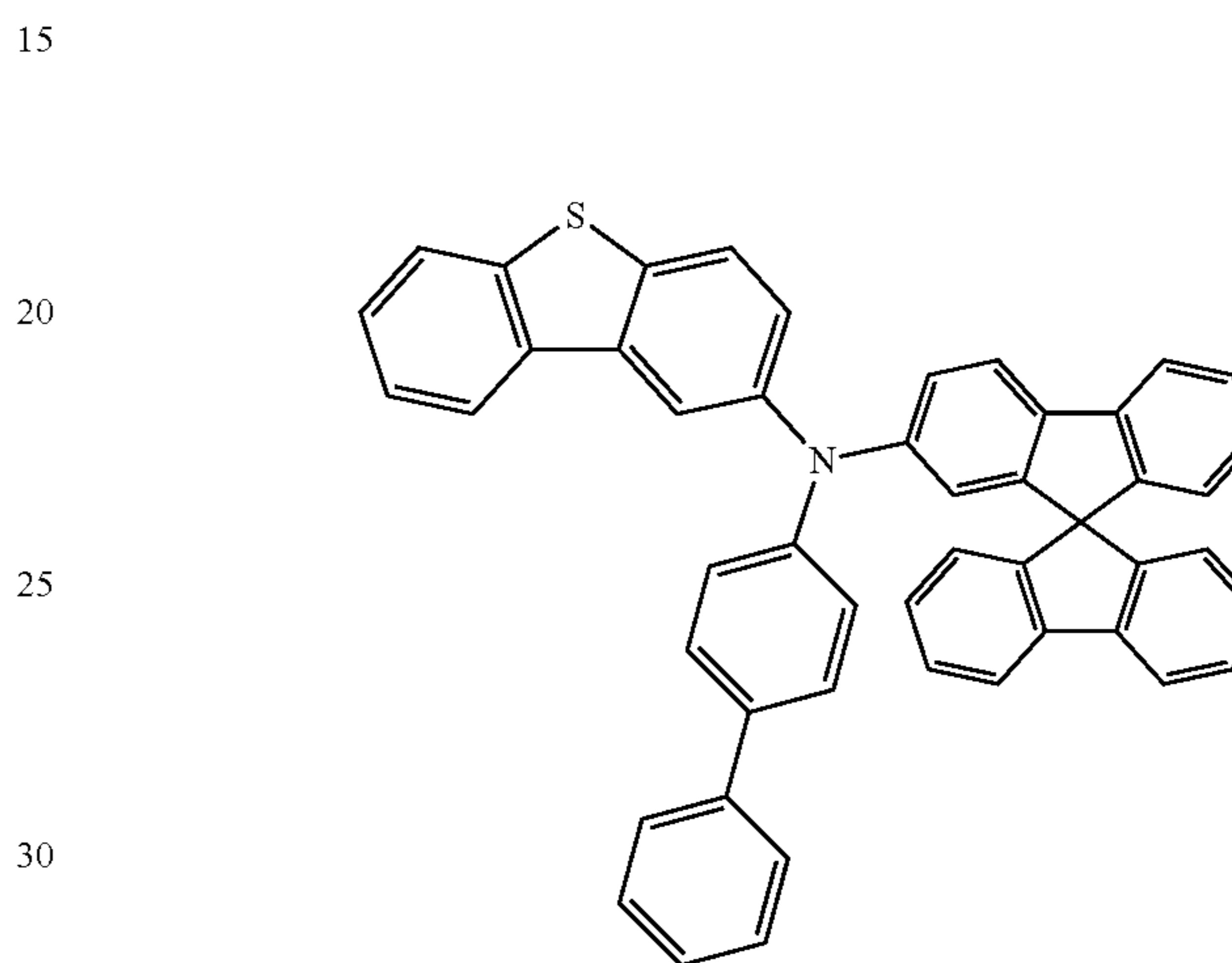
## Synthesis 1-24'



Sub 1-10

**106**  
-continued

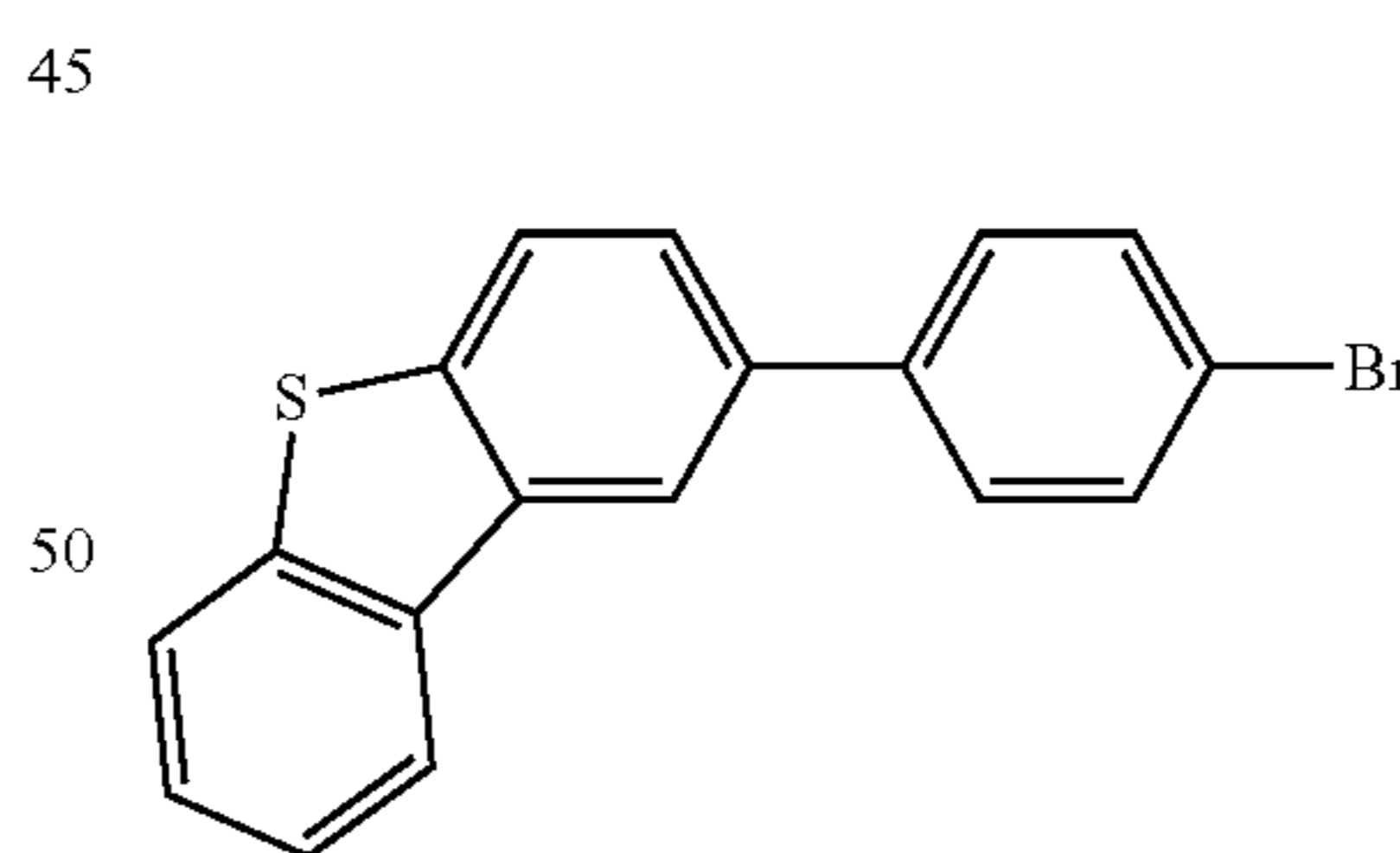
Sub 2-29



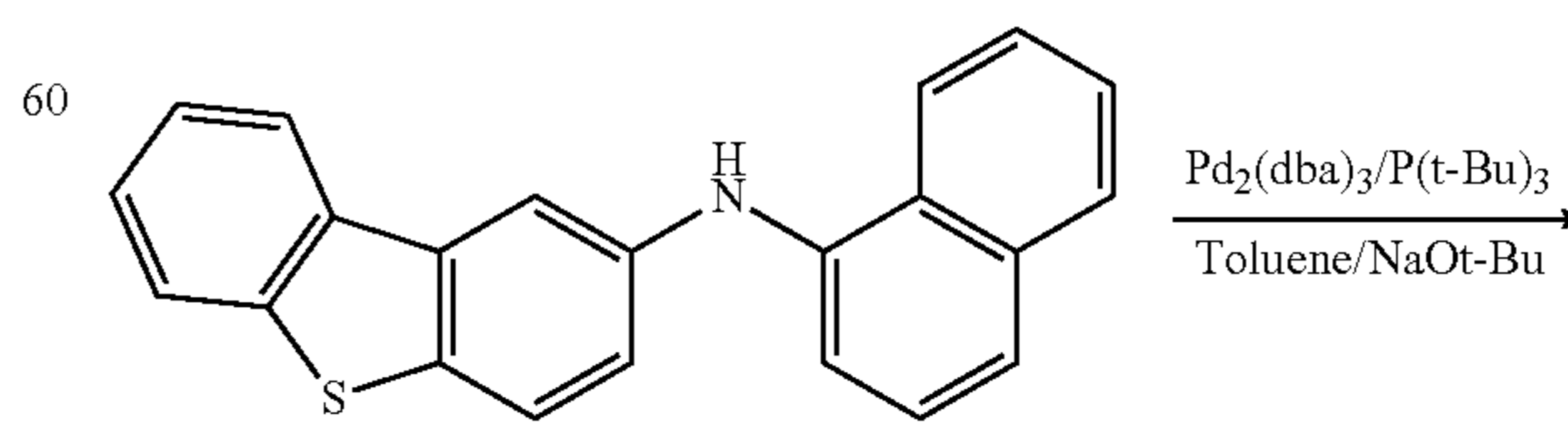
1-24'

In a round bottom flask, N-([1,1'-biphenyl]-4-yl)-9,9'-spirobi[fluoren]-2-amine (10 g, 20.7 mmol), 2-bromodibenzo[b,d]thiophene (6 g, 22.7 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (0.95 g, 1.03 mmol), P(t-Bu)<sub>3</sub> (0.42 g, 2.07 mmol), NaOt-Bu (6.55 g, 68.2 mmol), toluene (220 mL) were tested in the same manner as in the above 1-1' to obtain 10.2 g of Product 1-24'. (Yield: 74%).

## Synthesis 1-29'



Sub 1-11

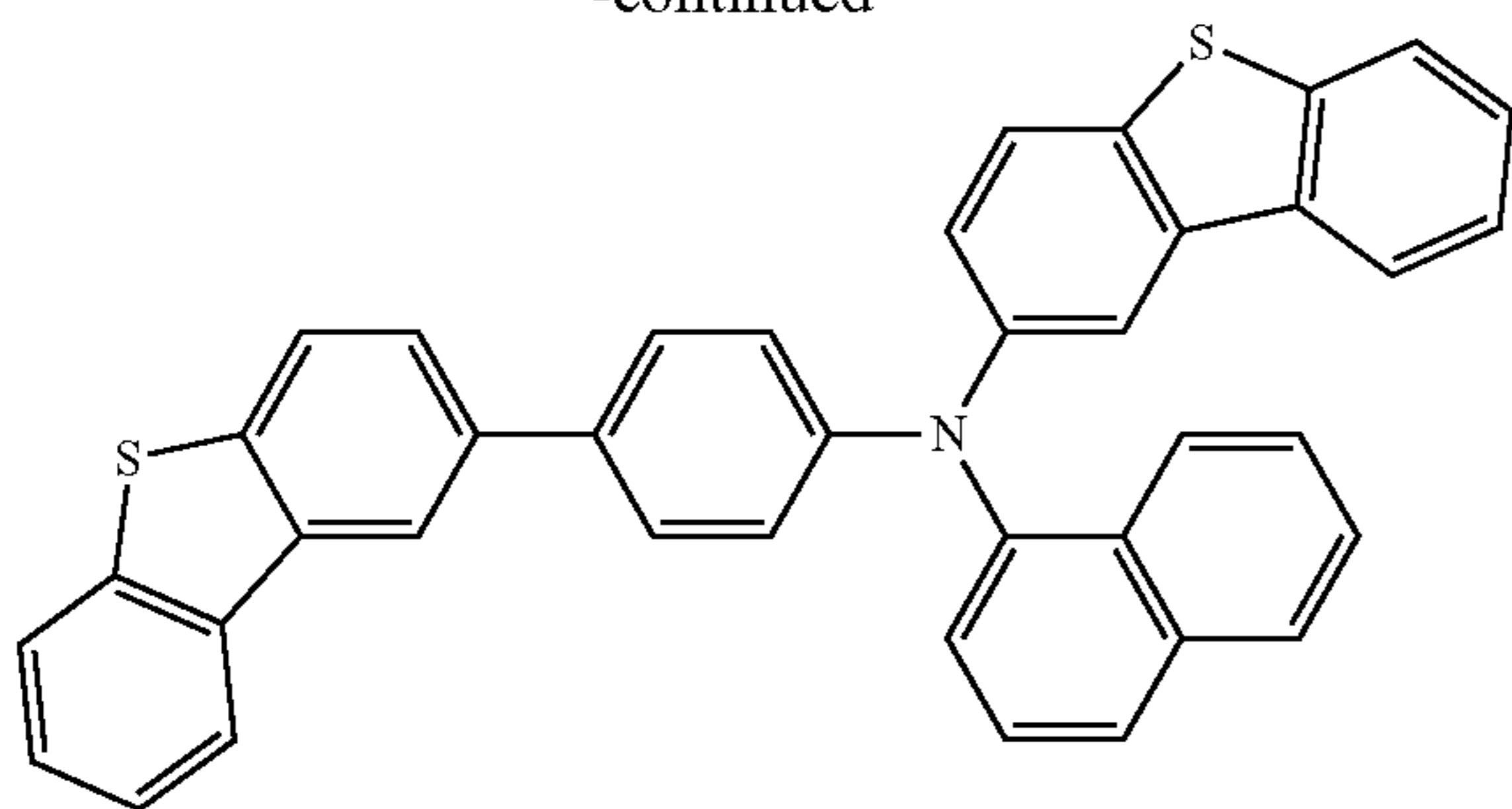


Sub 2-40



107

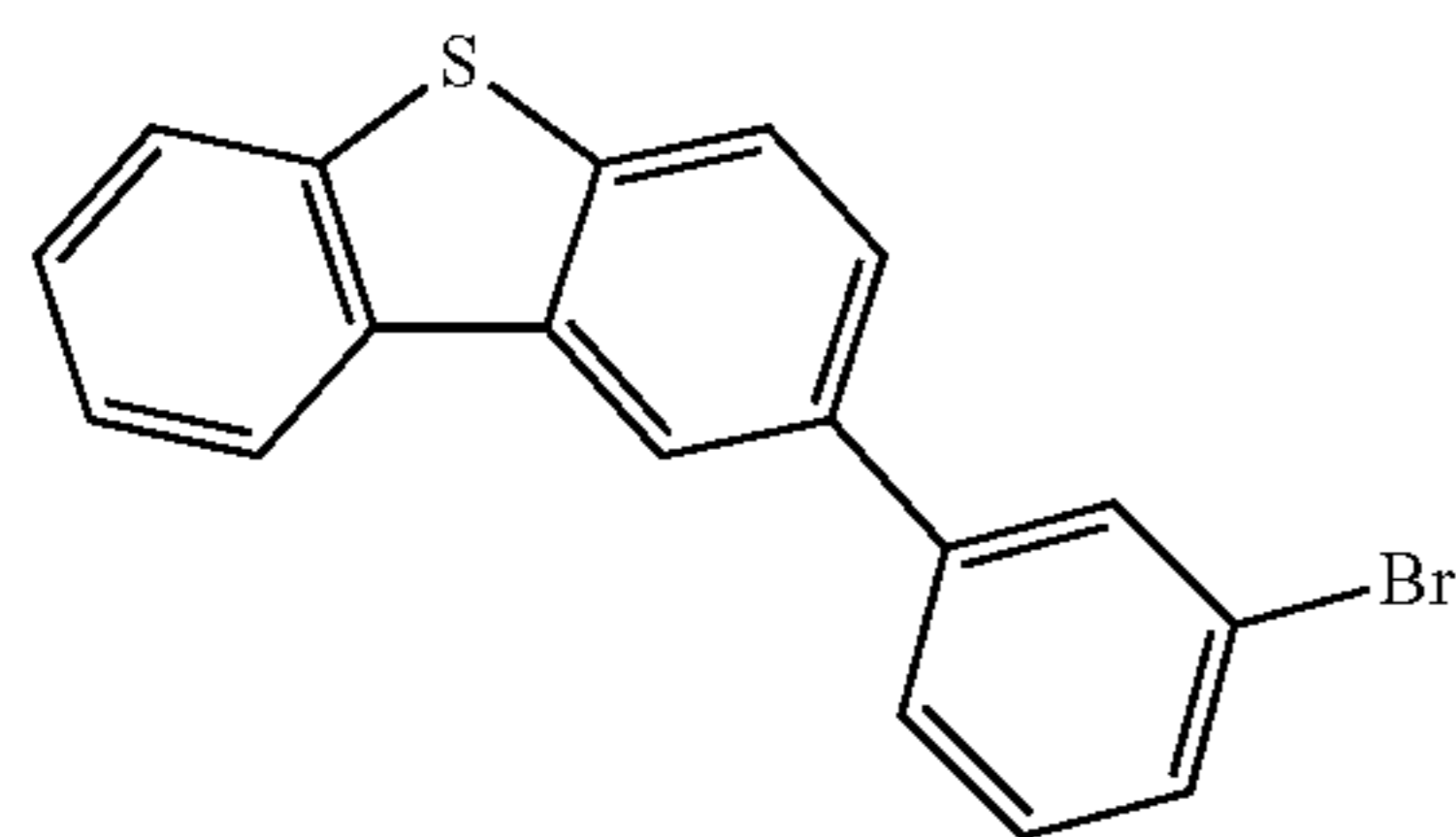
-continued



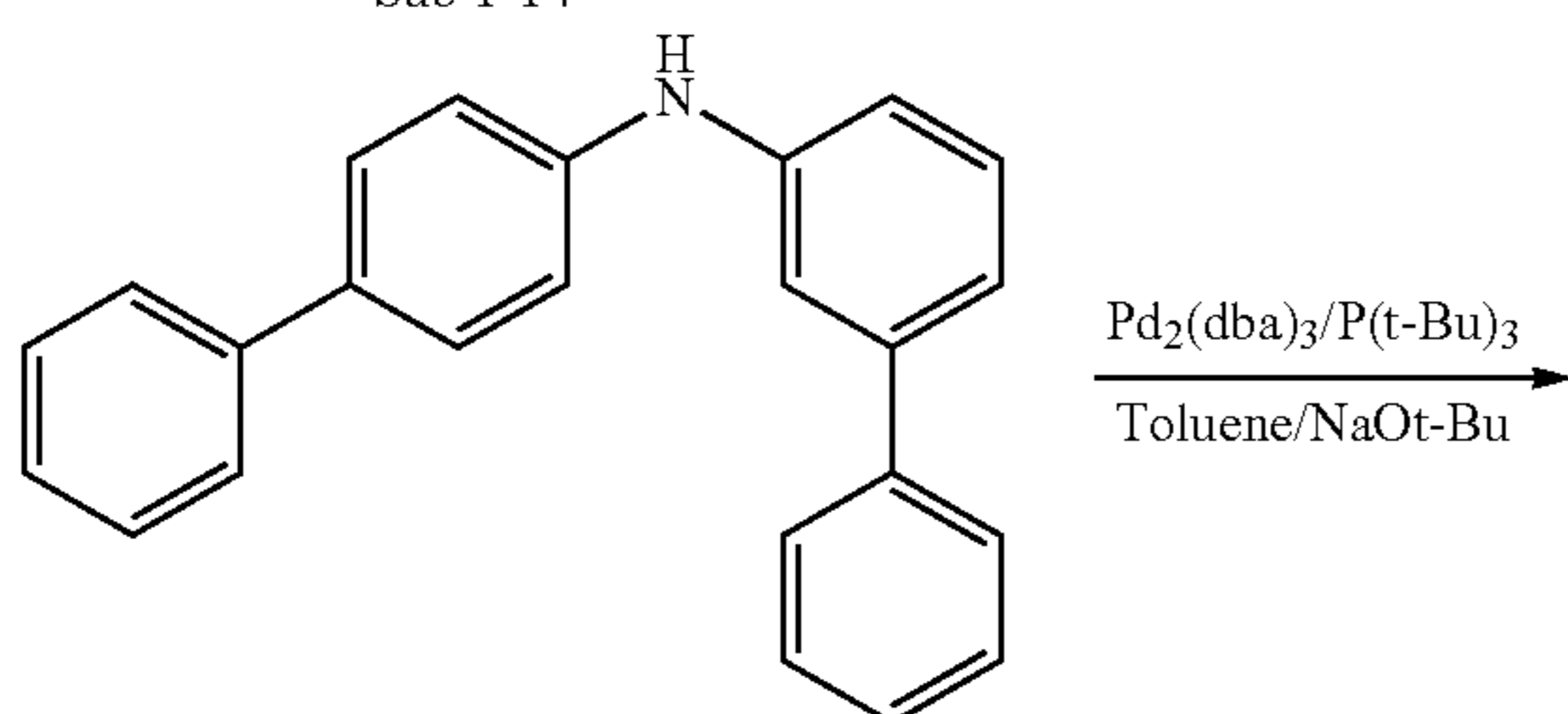
1-29'

In a round bottom flask, N-(naphthalen-1-yl)dibenzo[b,d]thiophen-2-amine (10 g, 30.7 mmol), 2-(4-bromophenyl)dibenzo[b,d]thiophene (11.5 g, 33.8 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.41 g, 1.54 mmol), P(t-Bu)<sub>3</sub> (0.62 g, 3.07 mmol), NaOt-Bu (9.75 g, 101.4 mmol), toluene (325 mL) were tested in the same manner as in the above 1-1' to obtain 12.9 g of Product 1-29'. (Yield: 72%).

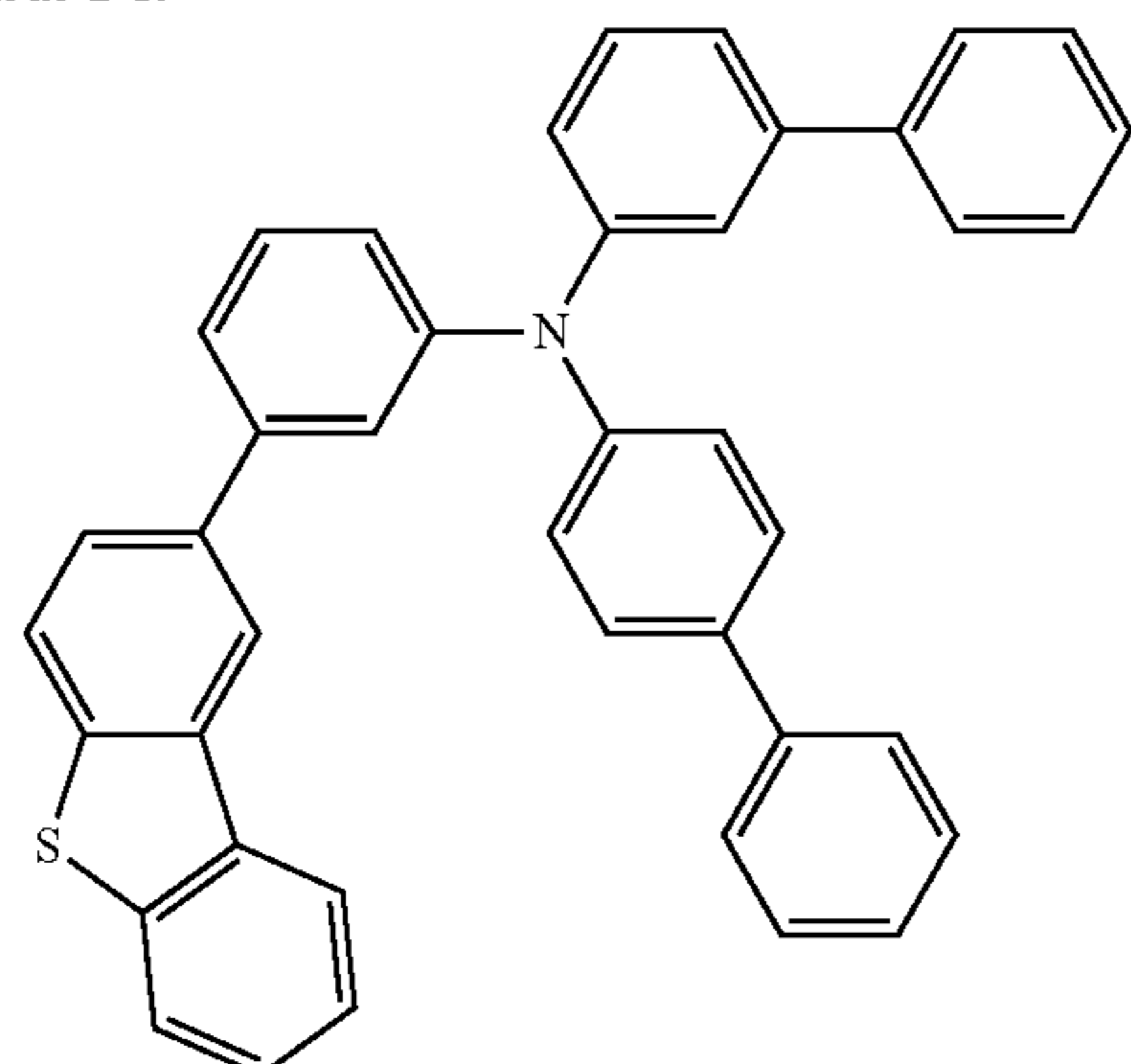
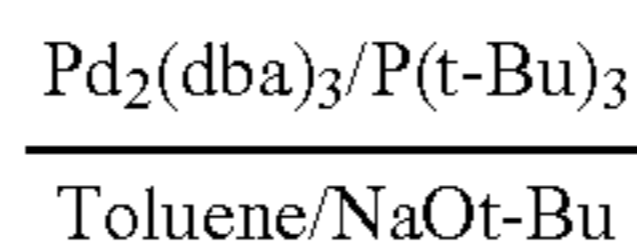
Synthesis 1-30'



Sub 1-14



Sub 2-19



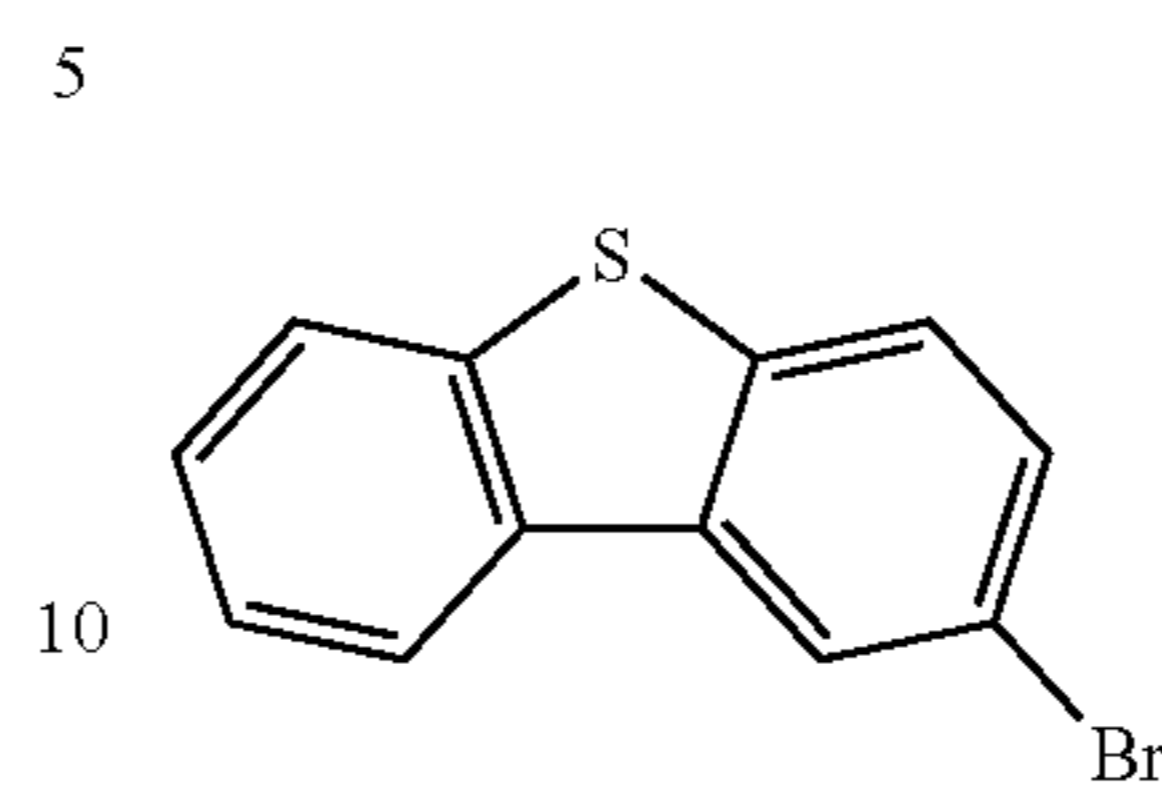
1-30'

In a round bottom flask, N-([1,1'-biphenyl]-4-yl)-[1,1'-biphenyl]-3-amine (10 g, 31.1 mmol), 2-(3-bromophenyl)dibenzo[b,d]thiophene (11.6 g, 34.2 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.42 g, 1.55 mmol), P(t-Bu)<sub>3</sub> (0.63 g, 3.11 mmol), NaOt-Bu (9.9

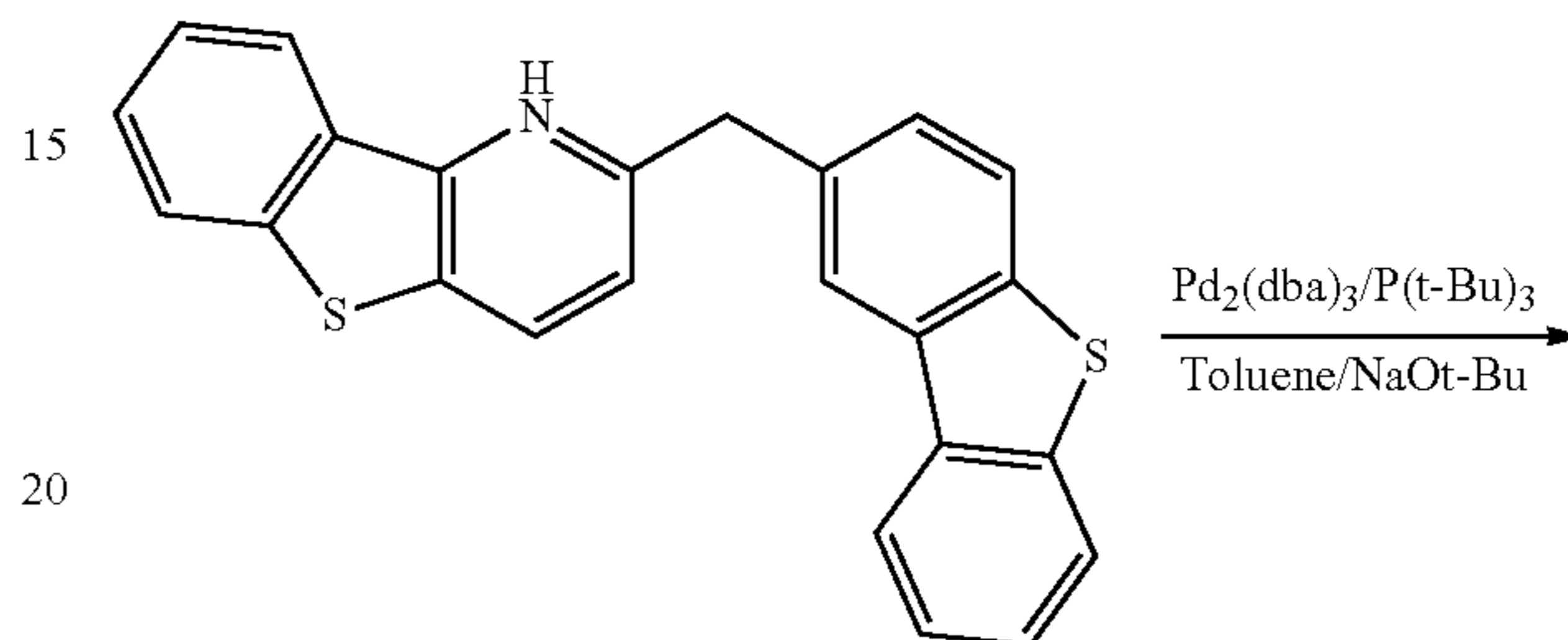
108

g, 103 mmol), toluene (330 mL) were tested in the same manner as in the above 1-1' to obtain 12.8 g of Product 1-30'. (Yield: 71%).

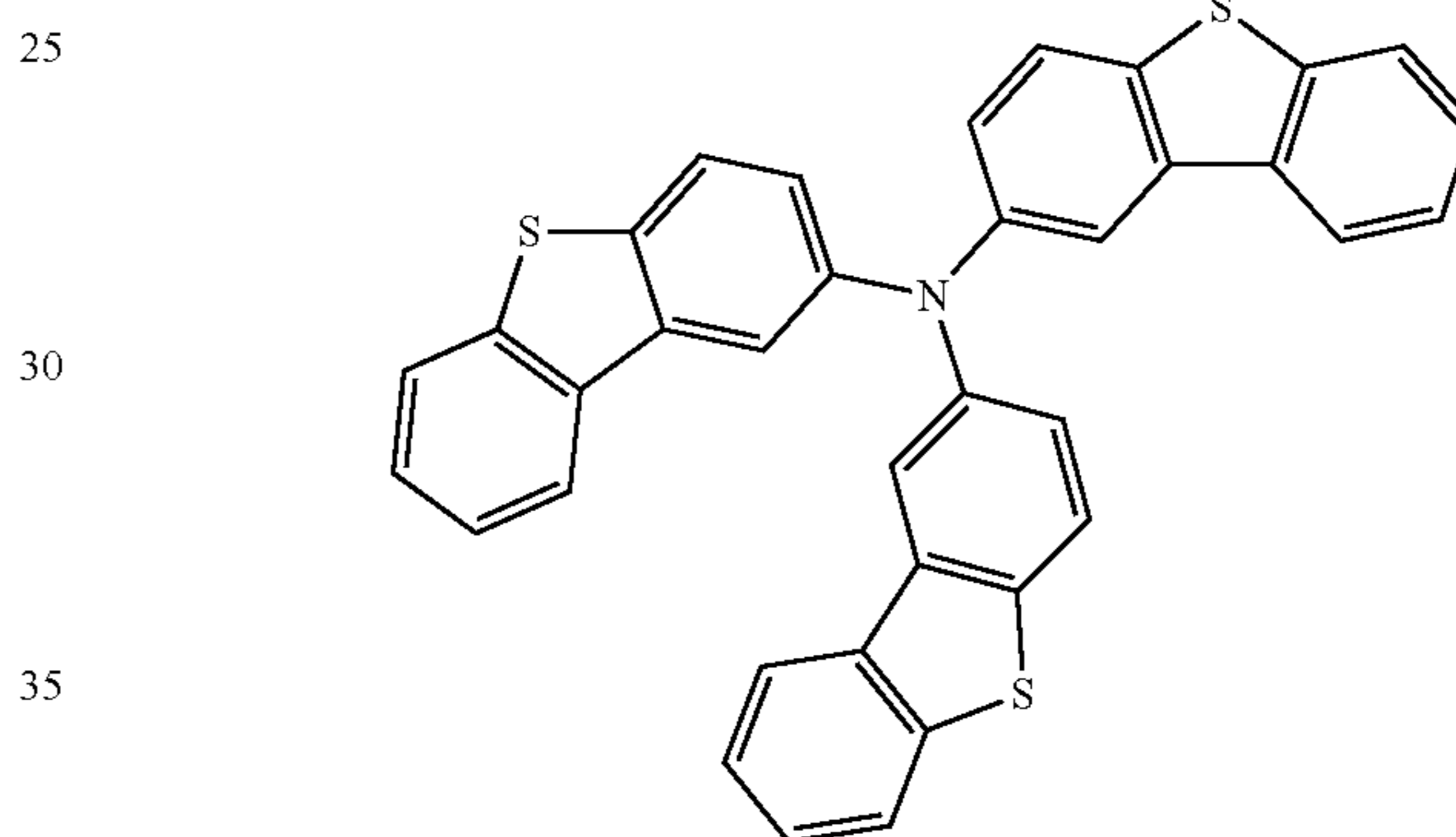
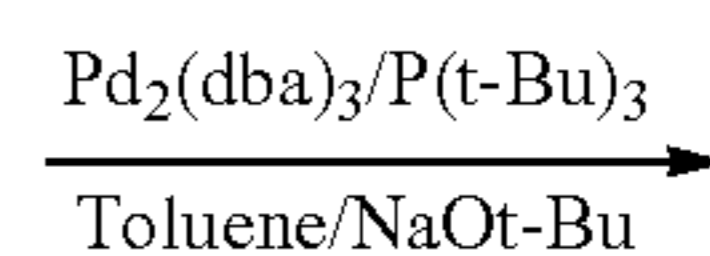
Synthesis 1-36'



Sub 1-10



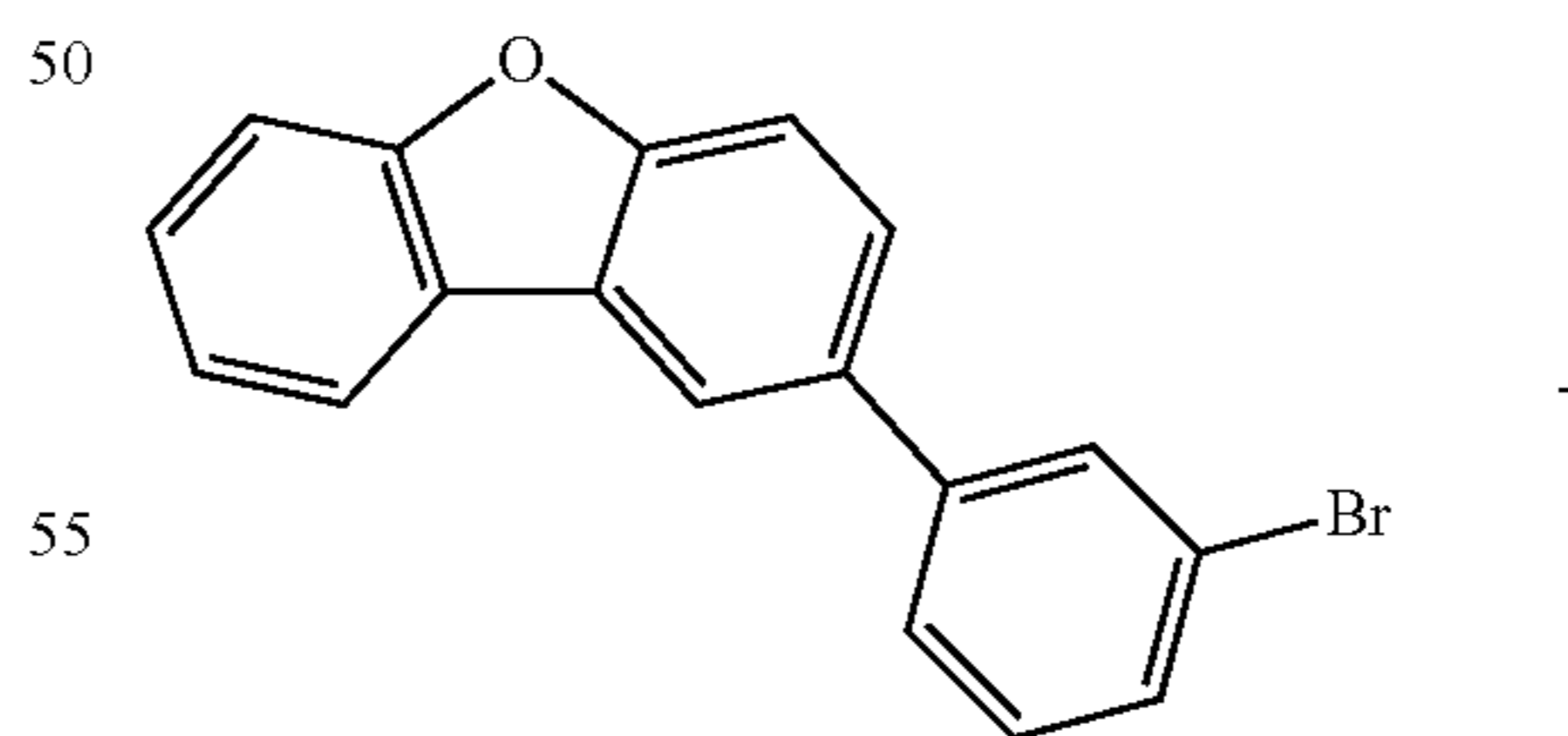
Sub 2-44



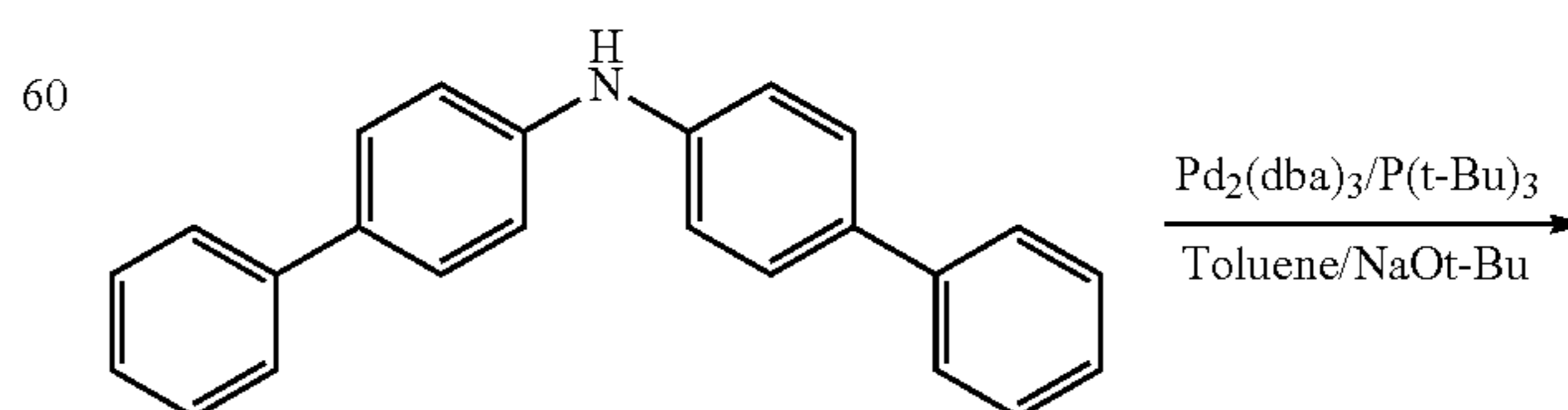
1-36'

In a round bottom flask, bis(dibenzo[b,d]thiophen-2-yl)amine (10 g, 26.2 mmol), 2-bromodibenzo[b,d]thiophene (7.59 g, 28.8 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.2 g, 1.31 mmol), P(t-Bu)<sub>3</sub> (0.53 g, 2.62 mmol), NaOt-Bu (8.31 g, 86.5 mmol), toluene (275 mL) were tested in the same manner as in the above 1-1' to obtain 11.4 g of Product 1-36'. (Yield: 77%).

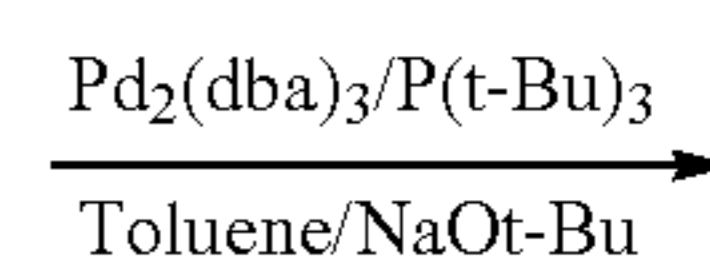
Synthesis 1-49'



Sub 1-21

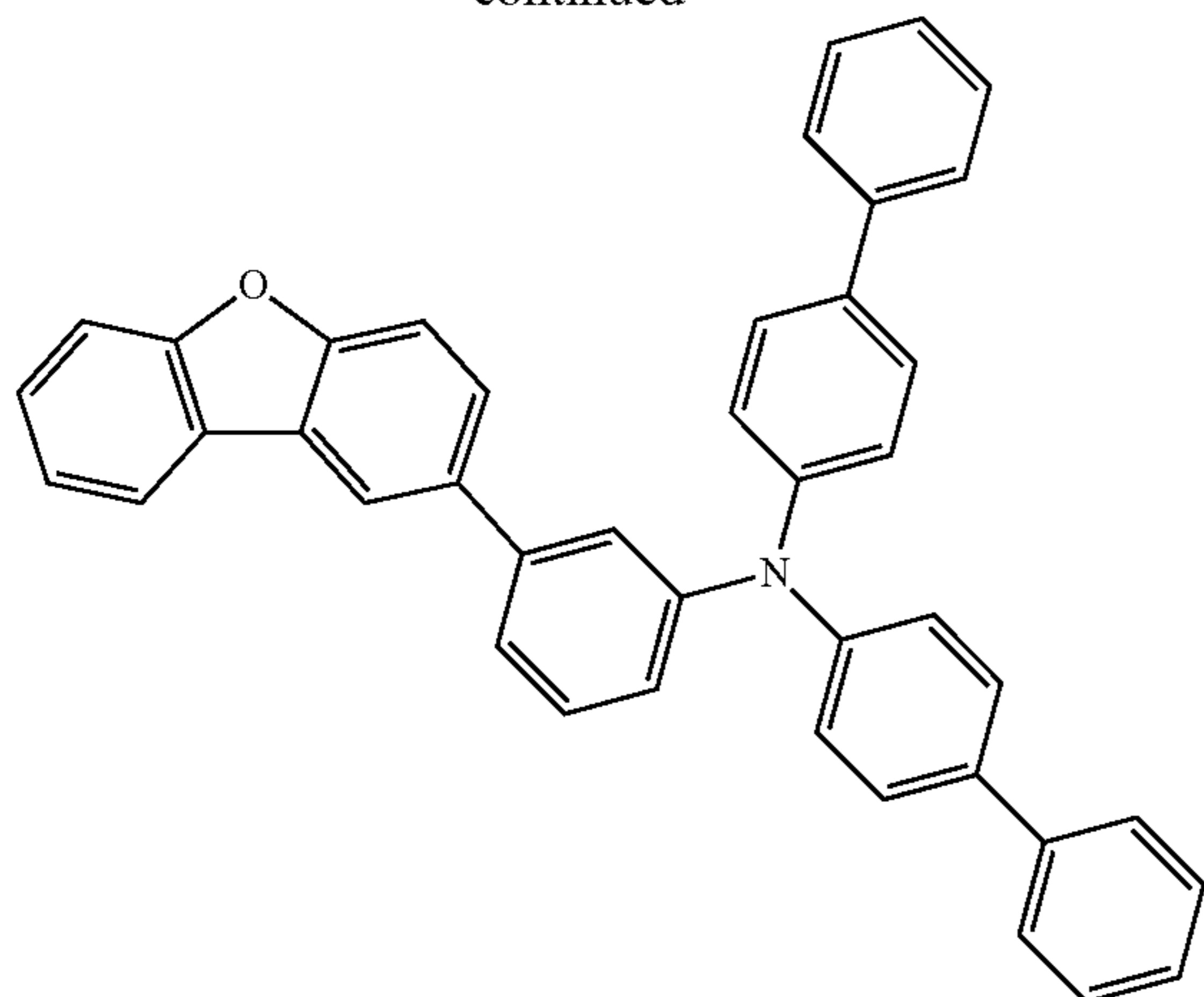


Sub 2-20



**109**

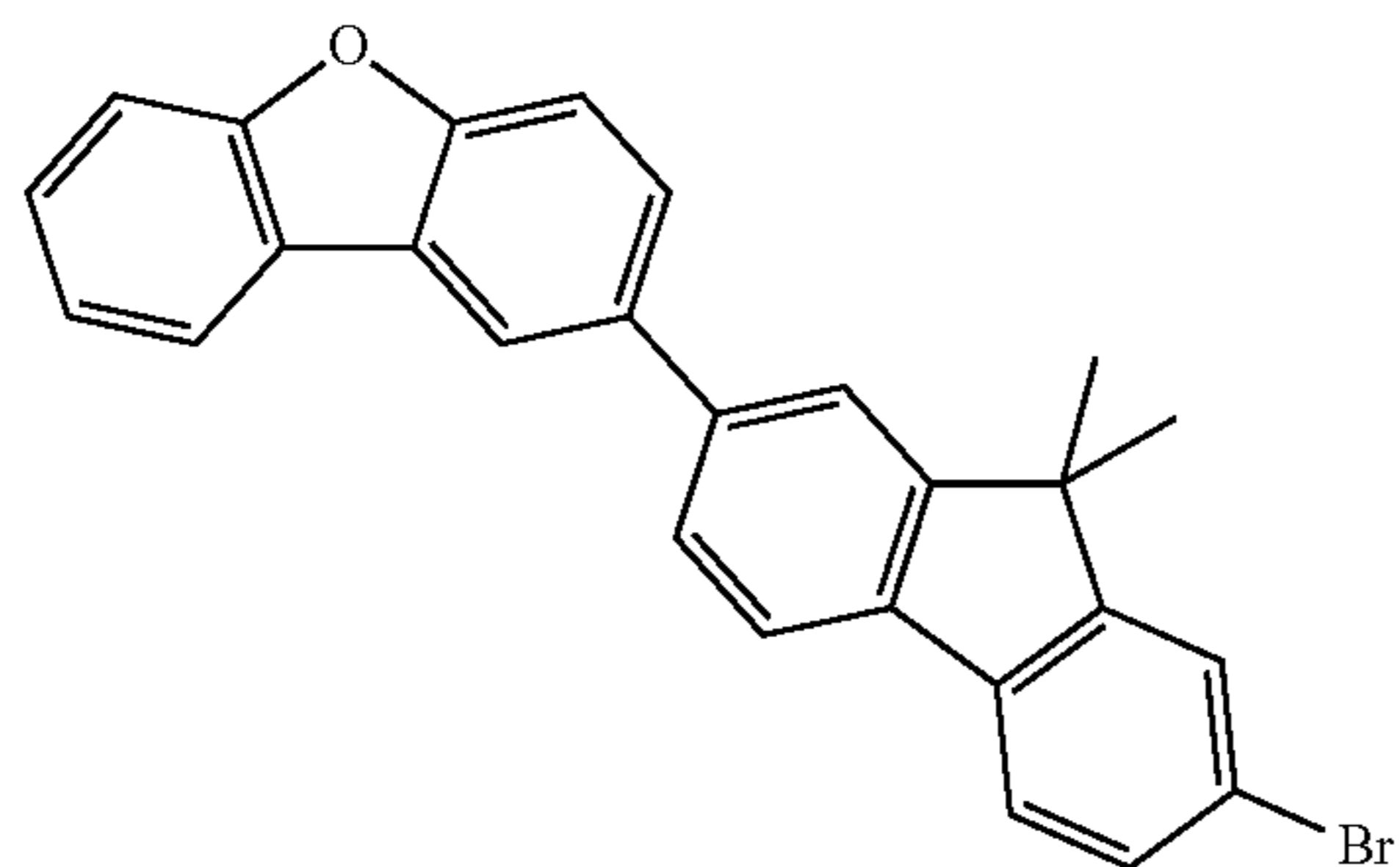
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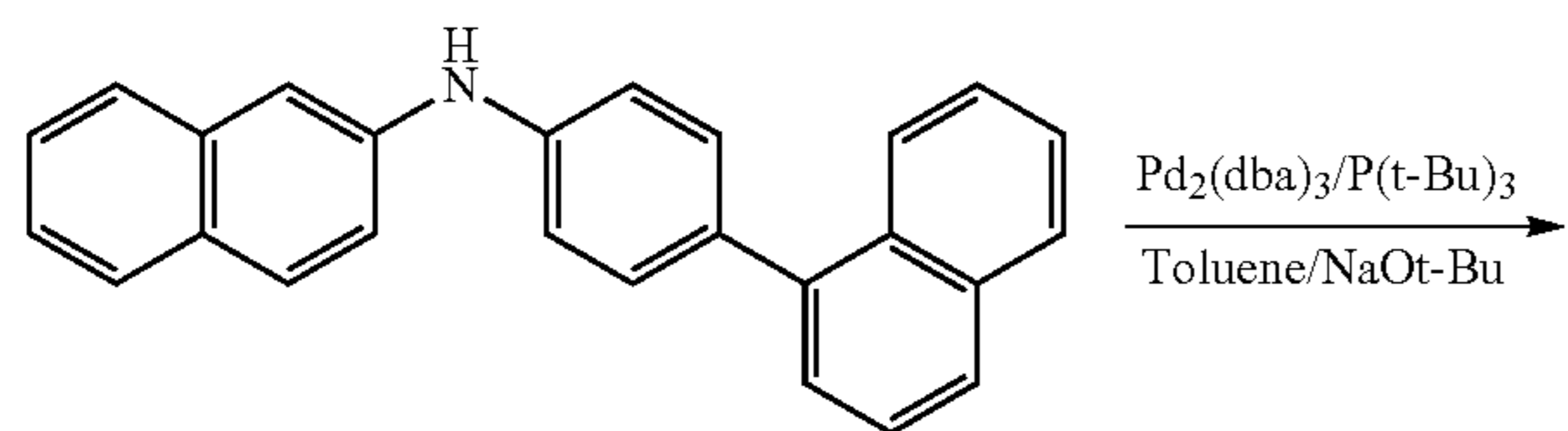
1-49'

In a round bottom flask, di([1,1'-biphenyl]-4-yl)amine (10 g, 31.1 mmol), 2-(3-bromophenyl)dibenzo[b,d]furan (11.1 g, 34.2 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.42 g, 1.56 mmol), P(t-Bu)<sub>3</sub> (0.63 g, 3.11 mmol), NaOt-Bu (9.9 g, 103 mmol), toluene (330 mL) were tested in the same manner as in the above 1-1' to obtain 13.3 g of Product 1-49'. (Yield: 76%).

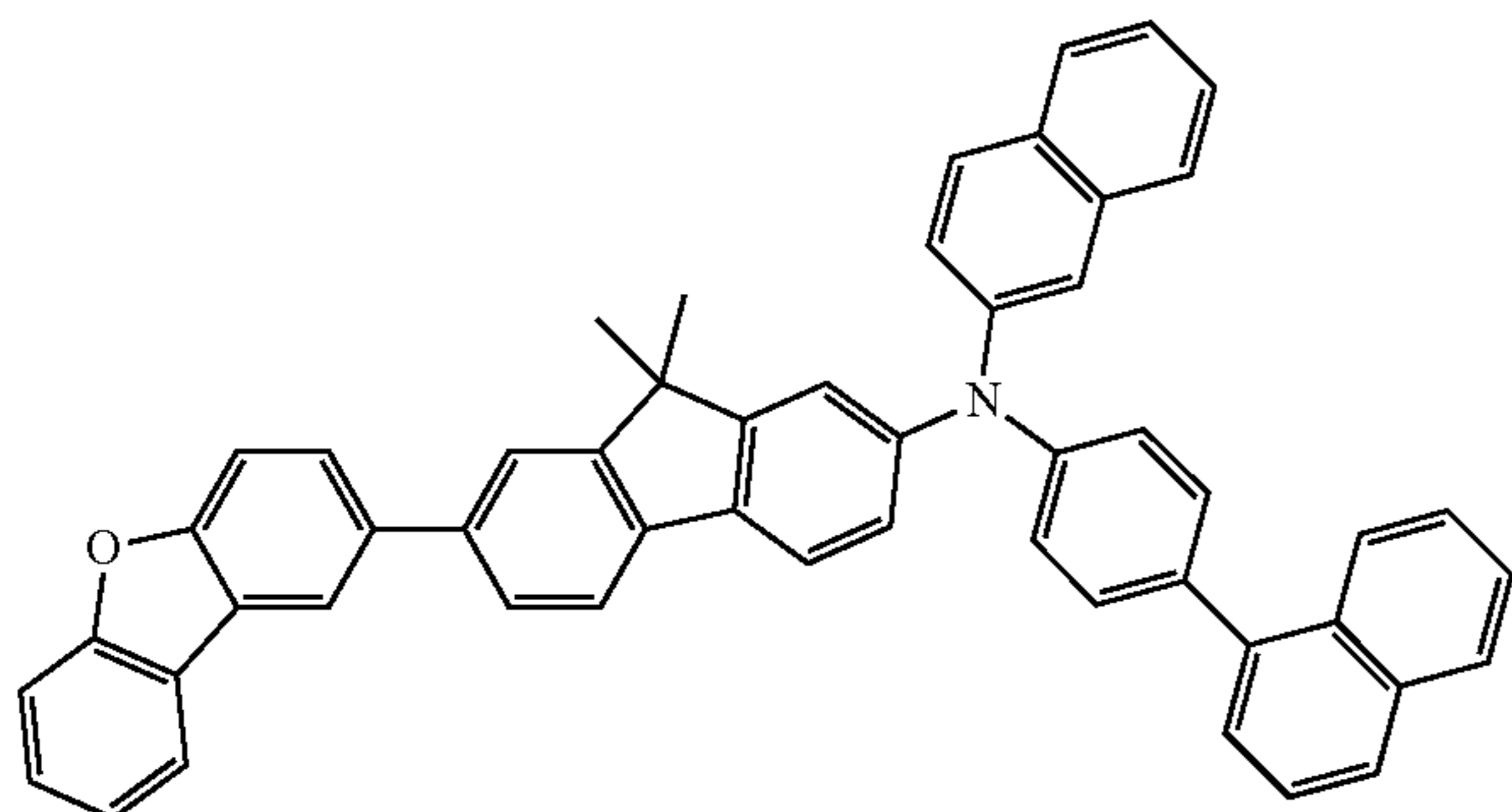
Synthesis 1-51'



Sub 1-23



Sub 2-9



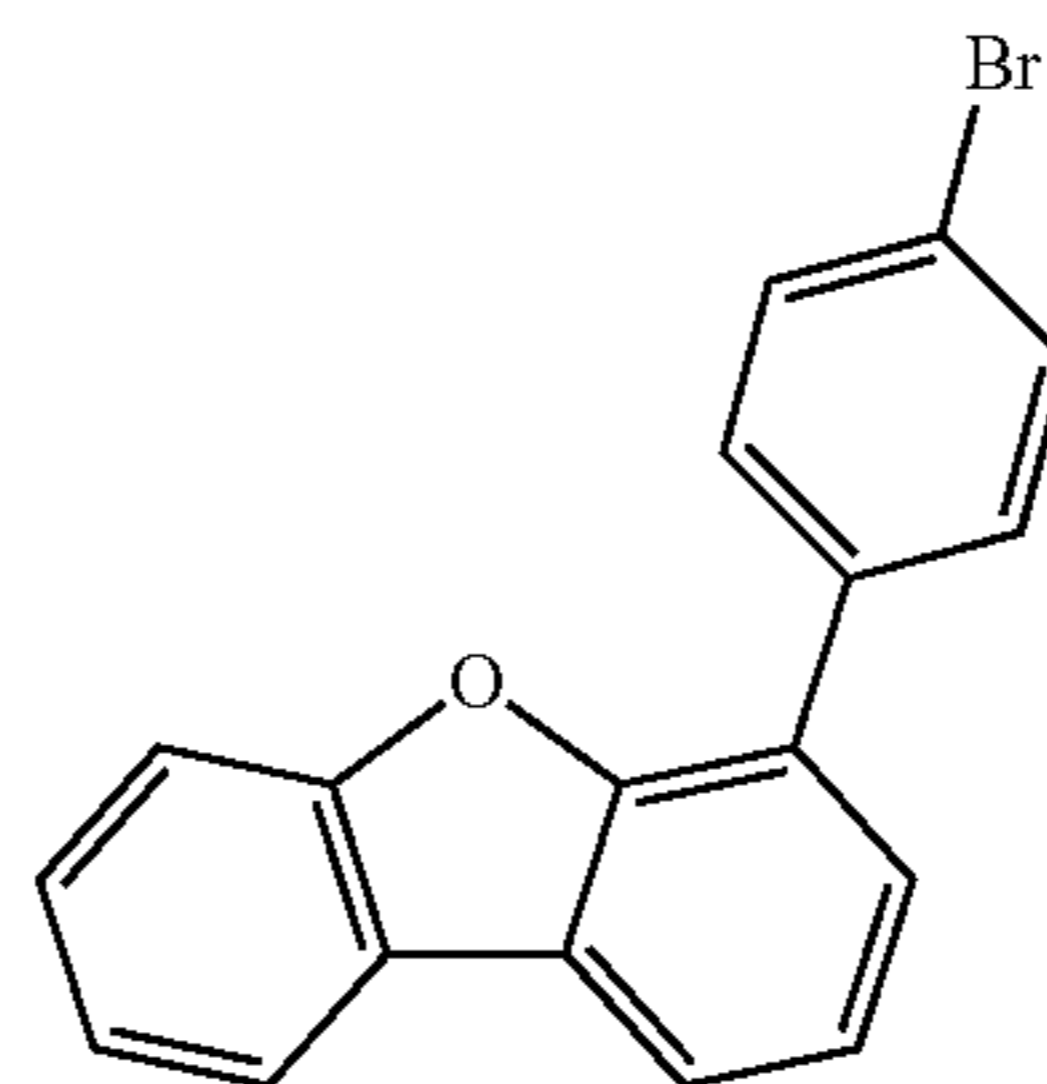
1-51'

In a round bottom flask, N-(4-(naphthalen-1-yl)phenyl) naphthalen-2-amine (10 g, 28.9 mmol), 2-(7-bromo-9,9-dimethyl-9H-fluoren-2-yl)dibenzo[b,d]furan (14 g, 32

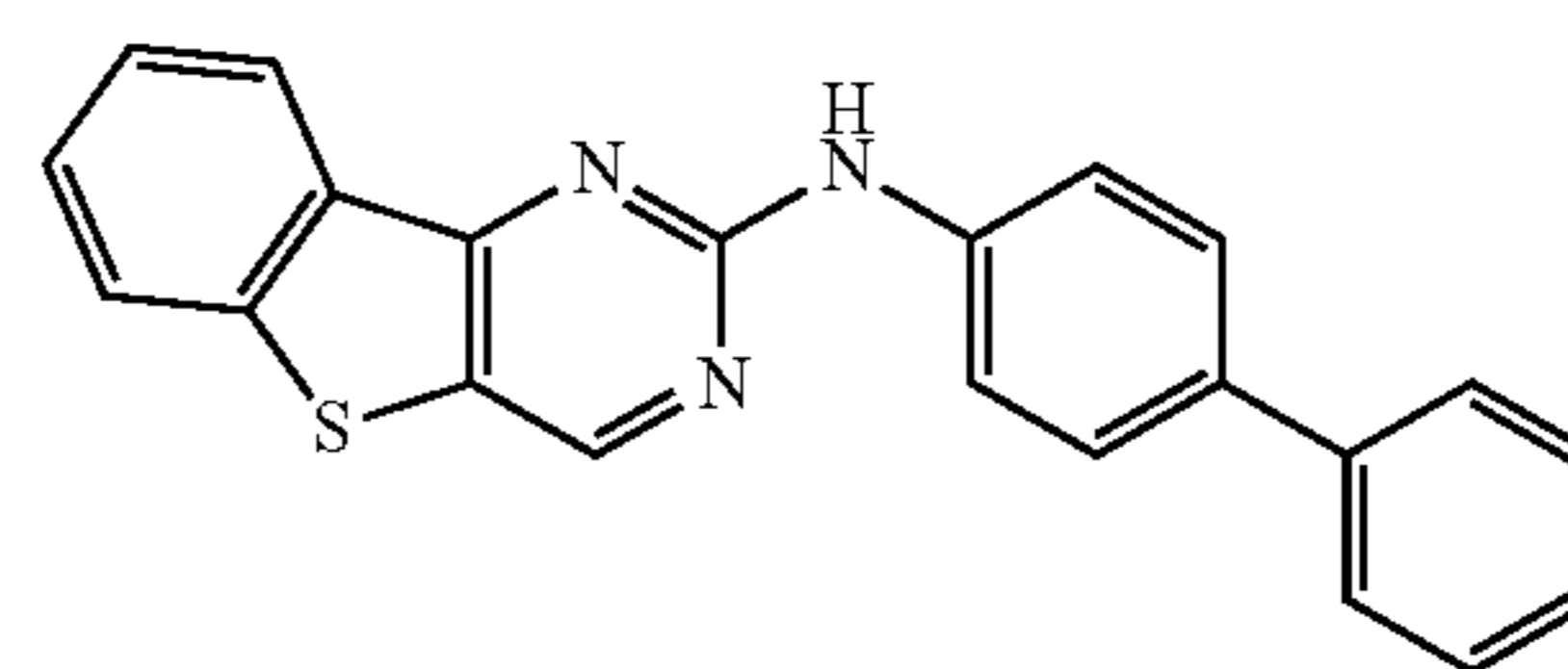
**110**

mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.33 g, 1.45 mmol), P(t-Bu)<sub>3</sub> (0.59 g, 2.9 mmol), NaOt-Bu (9.2 g, 95.5 mmol), toluene (310 mL) were tested in the same manner as in the above 1-1' to obtain 14.5 g of Product 1-51'. (Yield: 71%).

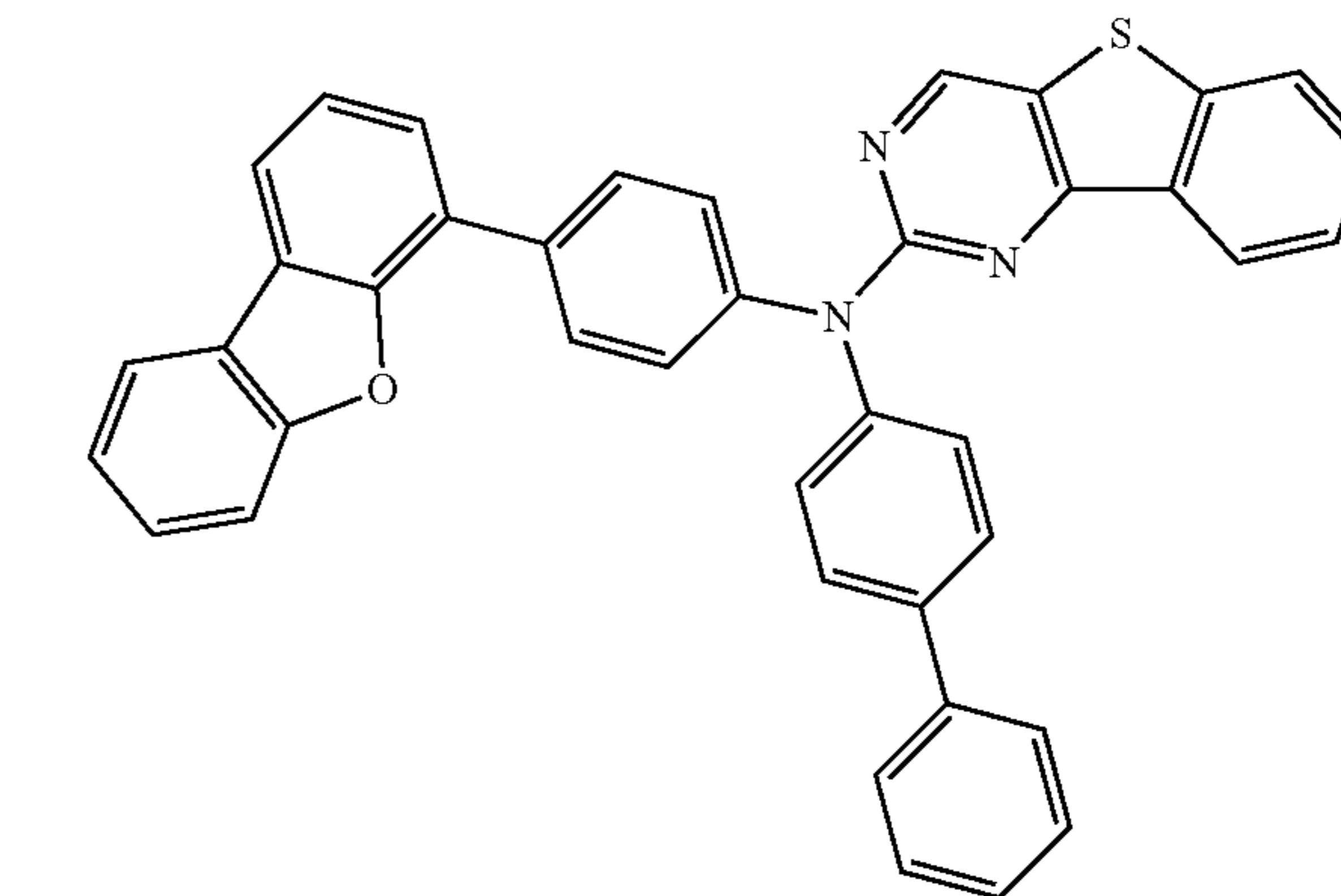
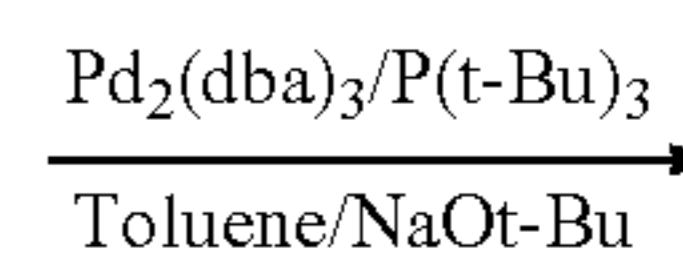
Synthesis 1-59'



Sub 1-25



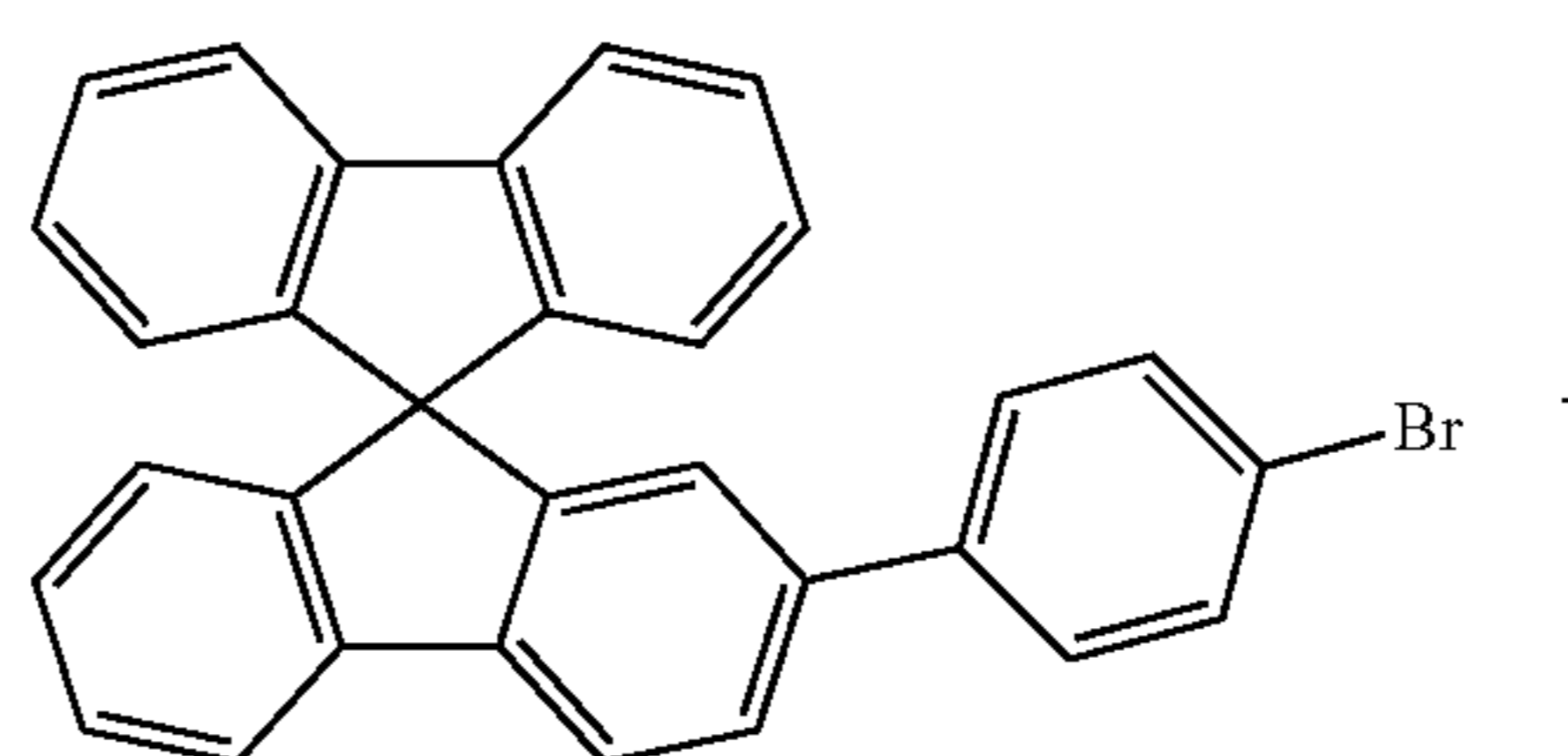
Sub 2-47



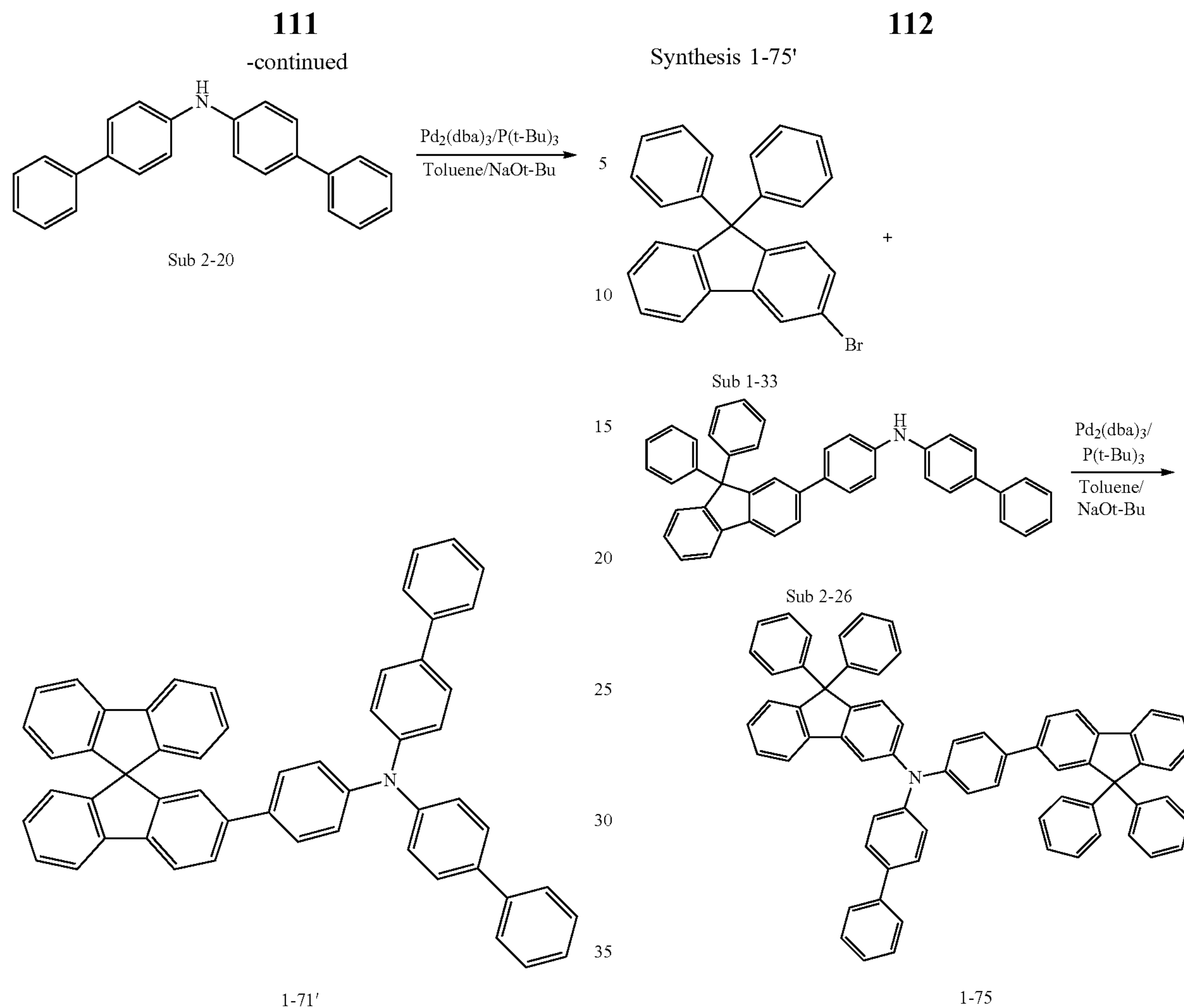
1-59'

In a round bottom flask, N-(4-(1,1'-biphenyl)-4-yl)benzo[4,5]thieno[3,2-d]pyrimidin-2-amine (10 g, 28.3 mmol), 4-(4-bromophenyl)dibenzo[b,d]furan (10.1 g, 31.1 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.3 g, 1.41 mmol), P(t-Bu)<sub>3</sub> (0.57 g, 2.83 mmol), NaOt-Bu (8.98 g, 93.4 mmol), toluene (300 mL) were tested in the same manner as in the above 1-1' to obtain 12.3 g of Product 1-59'. (Yield: 73%).

Synthesis 1-71'



Sub 1-32



In a round bottom flask, di([1,1'-biphenyl]-4-yl)amine (10 g, 31.1 mmol), 2-(4-bromophenyl)-9,9'-spirobi[fluorene] (16.1 g, 34.2 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (1.42 g, 1.56 mmol), P(t-Bu)<sub>3</sub> (0.63 g, 3.11 mmol), NaOt-Bu (9.87 g, 102.7 mmol), toluene (330 mL) were tested in the same manner as in the above 1-1' to obtain 15.5 g of Product 1-71'. (Yield: 70%).

In a round bottom flask, N-(4-(9,9-diphenyl-9H-fluoren-2-yl)phenyl)-[1,1'-biphenyl]-4-amine (10 g, 17.8 mmol), 3-bromo-9,9-diphenyl-9H-fluorene (7.78 g, 19.6 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (0.82 g, 0.89 mmol), P(t-Bu)<sub>3</sub> (0.36 g, 1.78 mmol), NaOt-Bu (5.65 g, 58.75 mmol), toluene (190 mL) were tested in the same manner as in the above 1-1' to obtain 11.3 g of Product 1-75'. (Yield: 72%).

TABLE 2

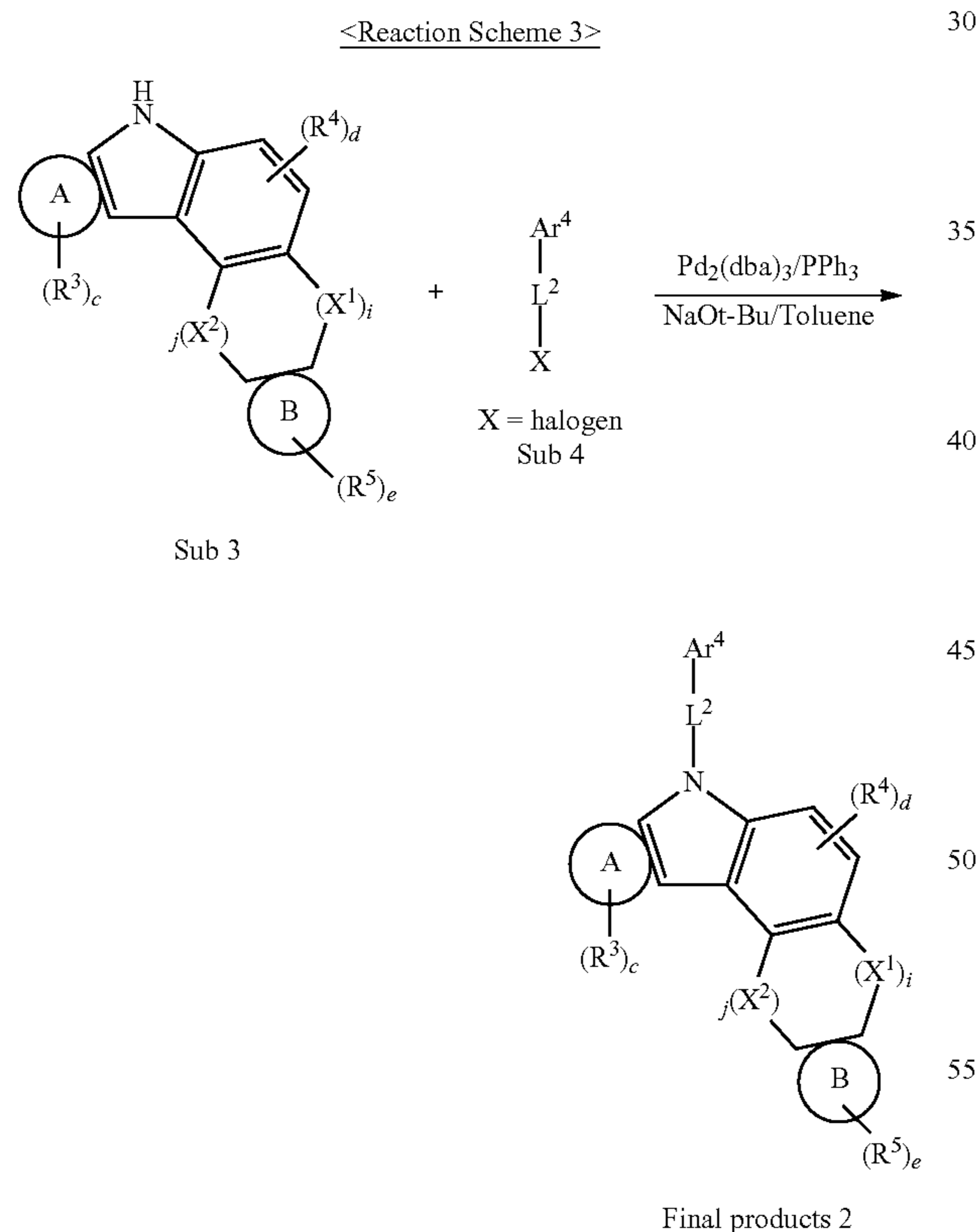
compound	FD-MS	compound	FD-MS
1-1'	m/z = 473.21(C <sub>36</sub> H <sub>27</sub> N = 473.61)	1-2'	m/z = 523.23(C <sub>40</sub> H <sub>29</sub> N = 523.66)
1-3'	m/z = 573.25(C <sub>44</sub> H <sub>31</sub> N = 573.72)	1-4'	m/z = 623.26(C <sub>48</sub> H <sub>33</sub> N = 623.78)
1-5'	m/z = 447.20(C <sub>34</sub> H <sub>25</sub> N = 447.57)	1-6'	m/z = 371.17(C <sub>28</sub> H <sub>21</sub> N = 371.47)
1-7'	m/z = 471.20(C <sub>36</sub> H <sub>25</sub> N = 471.59)	1-8'	m/z = 521.21(C <sub>40</sub> H <sub>27</sub> N = 521.65)
1-9'	m/z = 549.25(C <sub>42</sub> H <sub>31</sub> N = 549.70)	1-10'	m/z = 625.28(C <sub>48</sub> H <sub>35</sub> N = 625.80)
1-11'	m/z = 675.29(C <sub>52</sub> H <sub>37</sub> N = 675.86)	1-12'	m/z = 473.21(C <sub>36</sub> H <sub>27</sub> N = 473.61)
1-13'	m/z = 523.23(C <sub>40</sub> H <sub>29</sub> N = 523.66)	1-14'	m/z = 623.26(C <sub>48</sub> H <sub>33</sub> N = 623.78)
1-15'	m/z = 549.25(C <sub>42</sub> H <sub>31</sub> N = 549.70)	1-16'	m/z = 625.28(C <sub>48</sub> H <sub>35</sub> N = 625.80)
1-17'	m/z = 503.17(C <sub>36</sub> H <sub>25</sub> NS = 503.66)	1-18'	m/z = 603.20(C <sub>44</sub> H <sub>29</sub> NS = 603.77)
1-19'	m/z = 477.16(C <sub>34</sub> H <sub>23</sub> NS = 477.62)	1-20'	m/z = 503.17(C <sub>36</sub> H <sub>25</sub> NS = 503.66)
1-21'	m/z = 451.14(C <sub>32</sub> H <sub>21</sub> NS = 451.58)	1-22'	m/z = 593.22(C <sub>43</sub> H <sub>31</sub> NS = 593.78)
1-23'	m/z = 641.22(C <sub>47</sub> H <sub>31</sub> NS = 641.82)	1-24'	m/z = 665.22(C <sub>49</sub> H <sub>31</sub> NS = 665.84)
1-25'	m/z = 503.17(C <sub>36</sub> H <sub>25</sub> NS = 503.66)	1-26'	m/z = 655.23(C <sub>48</sub> H <sub>33</sub> NS = 655.85)
1-27'	m/z = 695.26(C <sub>51</sub> H <sub>37</sub> NS = 695.91)	1-28'	m/z = 593.18(C <sub>42</sub> H <sub>27</sub> NOS = 593.73)
1-29'	m/z = 583.14(C <sub>40</sub> H <sub>25</sub> NS <sub>2</sub> = 583.76)	1-30'	m/z = 579.20(C <sub>42</sub> H <sub>29</sub> NS = 579.75)
1-31'	m/z = 685.19(C <sub>48</sub> H <sub>31</sub> NS <sub>2</sub> = 685.90)	1-32'	m/z = 719.23(C <sub>52</sub> H <sub>33</sub> NOS = 719.89)
1-33'	m/z = 629.22(C <sub>46</sub> H <sub>31</sub> NS = 629.81)	1-34'	m/z = 629.22(C <sub>46</sub> H <sub>31</sub> NS = 629.81)
1-35'	m/z = 603.20(C <sub>44</sub> H <sub>29</sub> NS = 603.77)	1-36'	m/z = 563.08(C <sub>36</sub> H <sub>21</sub> NS <sub>3</sub> = 563.75)
1-37'	m/z = 639.11(C <sub>42</sub> H <sub>25</sub> NS <sub>3</sub> = 639.85)	1-38'	m/z = 715.15(C <sub>48</sub> H <sub>29</sub> NS <sub>3</sub> = 715.95)
1-39'	m/z = 791.18(C <sub>54</sub> H <sub>33</sub> NS <sub>3</sub> = 792.04)	1-40'	m/z = 607.16(C <sub>42</sub> H <sub>25</sub> NO <sub>2</sub> S = 607.72)
1-41'	m/z = 633.21(C <sub>45</sub> H <sub>31</sub> NOS = 633.80)	1-42'	m/z = 733.24(C <sub>53</sub> H <sub>35</sub> NOS = 733.92)

TABLE 2-continued

compound	FD-MS	compound	FD-MS
1-43'	m/z = 883.29(C <sub>65</sub> H <sub>41</sub> NOS = 884.09)	1-44'	m/z = 585.13(C <sub>38</sub> H <sub>23</sub> N <sub>3</sub> S <sub>2</sub> = 585.74)
1-45'	m/z = 553.19(C <sub>40</sub> H <sub>27</sub> NS = 55.71)	1-46'	m/z = 603.20(C <sub>44</sub> H <sub>29</sub> NS = 603.77)
1-47'	m/z = 841.28(C <sub>63</sub> H <sub>39</sub> NS = 842.06)	1-48'	m/z = 563.22(C <sub>42</sub> H <sub>29</sub> NO = 563.69)
1-49'	m/z = 563.22(C <sub>42</sub> H <sub>29</sub> NO = 563.69)	1-50'	m/z = 613.24(C <sub>46</sub> H <sub>31</sub> NO = 613.76)
1-51'	m/z = 703.29(C <sub>53</sub> H <sub>37</sub> NO = 703.87)	1-52'	m/z = 587.22(C <sub>44</sub> H <sub>29</sub> NO = 587.71)
1-53'	m/z = 639.26(C <sub>48</sub> H <sub>33</sub> NO = 639.78)	1-54'	m/z = 639.26(C <sub>48</sub> H <sub>33</sub> NO = 639.78)
1-55'	m/z = 653.24(C <sub>48</sub> H <sub>31</sub> NO <sub>2</sub> = 653.77)	1-56'	m/z = 603.26(C <sub>45</sub> H <sub>33</sub> NO = 603.75)
1-57'	m/z = 727.29(C <sub>55</sub> H <sub>37</sub> NO = 727.89)	1-58'	m/z = 725.27(C <sub>55</sub> H <sub>35</sub> NO = 725.87)
1-59'	m/z = 595.17(C <sub>40</sub> H <sub>25</sub> N <sub>3</sub> OS = 595.71)	1-60'	m/z = 567.26(C <sub>42</sub> H <sub>33</sub> NO = 567.72)
1-61'	m/z = 611.22(C <sub>46</sub> H <sub>29</sub> NO = 611.73)	1-62'	m/z = 617.18(C <sub>44</sub> H <sub>27</sub> NOS = 617.76)
1-63'	m/z = 637.24(C <sub>48</sub> H <sub>31</sub> NO = 637.77)	1-64'	m/z = 667.21(C <sub>48</sub> H <sub>29</sub> NO <sub>3</sub> = 667.75)
1-65'	m/z = 767.25(C <sub>56</sub> H <sub>33</sub> NO <sub>3</sub> = 767.87)	1-66'	m/z = 681.27(C <sub>50</sub> H <sub>35</sub> NO <sub>2</sub> = 681.82)
1-67'	m/z = 658.22(C <sub>45</sub> H <sub>30</sub> N <sub>4</sub> S = 658.82)	1-68'	m/z = 655.23(C <sub>48</sub> H <sub>33</sub> NS = 655.86)
1-69'	m/z = 744.26(C <sub>54</sub> H <sub>36</sub> N <sub>2</sub> S = 744.96)	1-70'	m/z = 784.27(C <sub>55</sub> H <sub>36</sub> N <sub>4</sub> S = 784.98)
1-71'	m/z = 553.19(C <sub>40</sub> H <sub>27</sub> NS = 553.72)	1-72'	m/z = 553.19(C <sub>40</sub> H <sub>27</sub> NS = 553.72)
1-73'	m/z = 543.20(C <sub>39</sub> H <sub>29</sub> NS = 543.73)	1-74'	m/z = 671.21(C <sub>48</sub> H <sub>30</sub> FNS = 671.83)
1-75'	m/z = 641.25(C <sub>46</sub> H <sub>31</sub> N <sub>3</sub> O = 641.77)	1-76'	m/z = 639.26(C <sub>48</sub> H <sub>33</sub> NO = 639.80)
1-77'	m/z = 652.25(C <sub>48</sub> H <sub>32</sub> N <sub>2</sub> O = 652.80)	1-78'	m/z = 614.24(C <sub>45</sub> H <sub>30</sub> N <sub>2</sub> O = 614.75)
1-79'	m/z = 587.22(C <sub>44</sub> H <sub>29</sub> NO = 587.72)	1-80'	m/z = 613.24(C <sub>46</sub> H <sub>31</sub> NO = 613.76)
1-81'	m/z = 543.26(C <sub>40</sub> H <sub>33</sub> NO = 543.71)	1-82'	m/z = 667.25(C <sub>49</sub> H <sub>33</sub> NO <sub>2</sub> = 667.81)

## Synthesis Examples 2

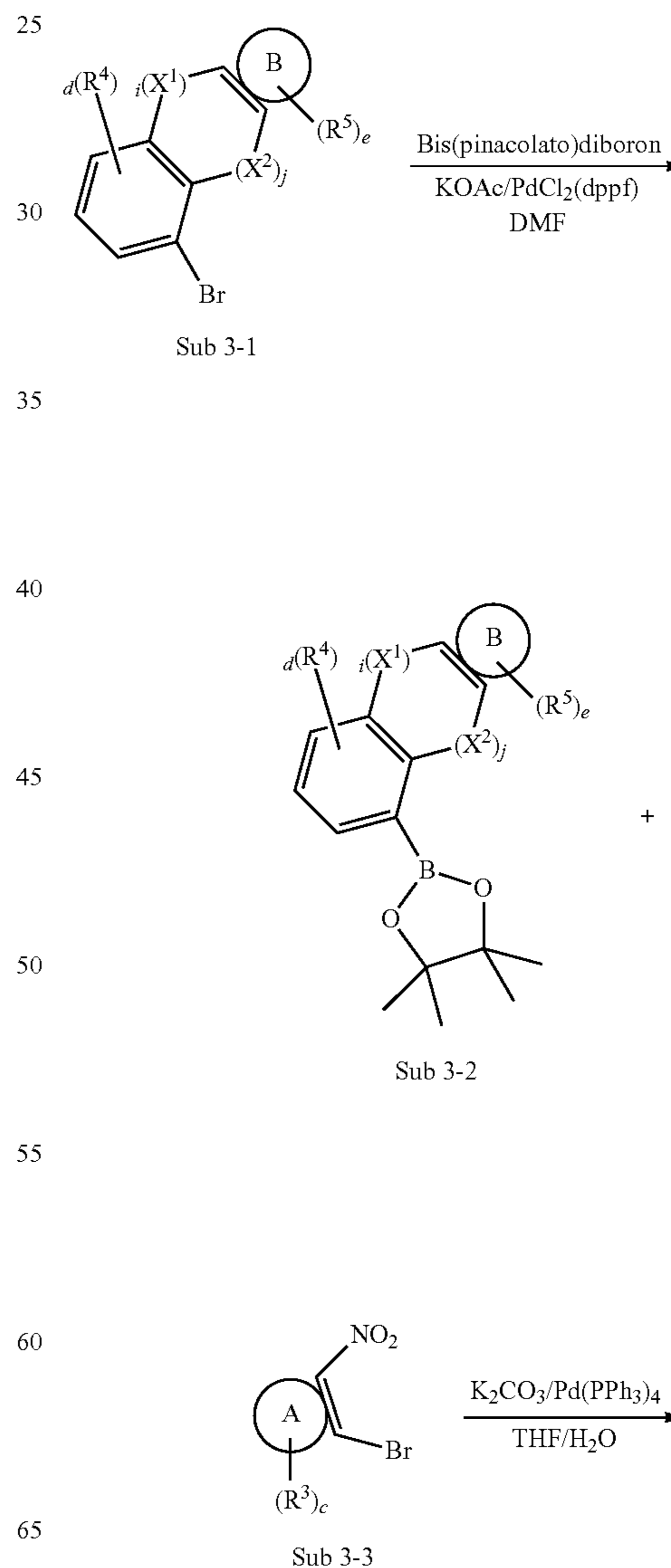
The final product 2 represented by Formula (2) of the present invention is prepared by reacting Sub 3 and Sub 4 as shown in the following Reaction Scheme 3.



## Synthesis Example of Sub 3

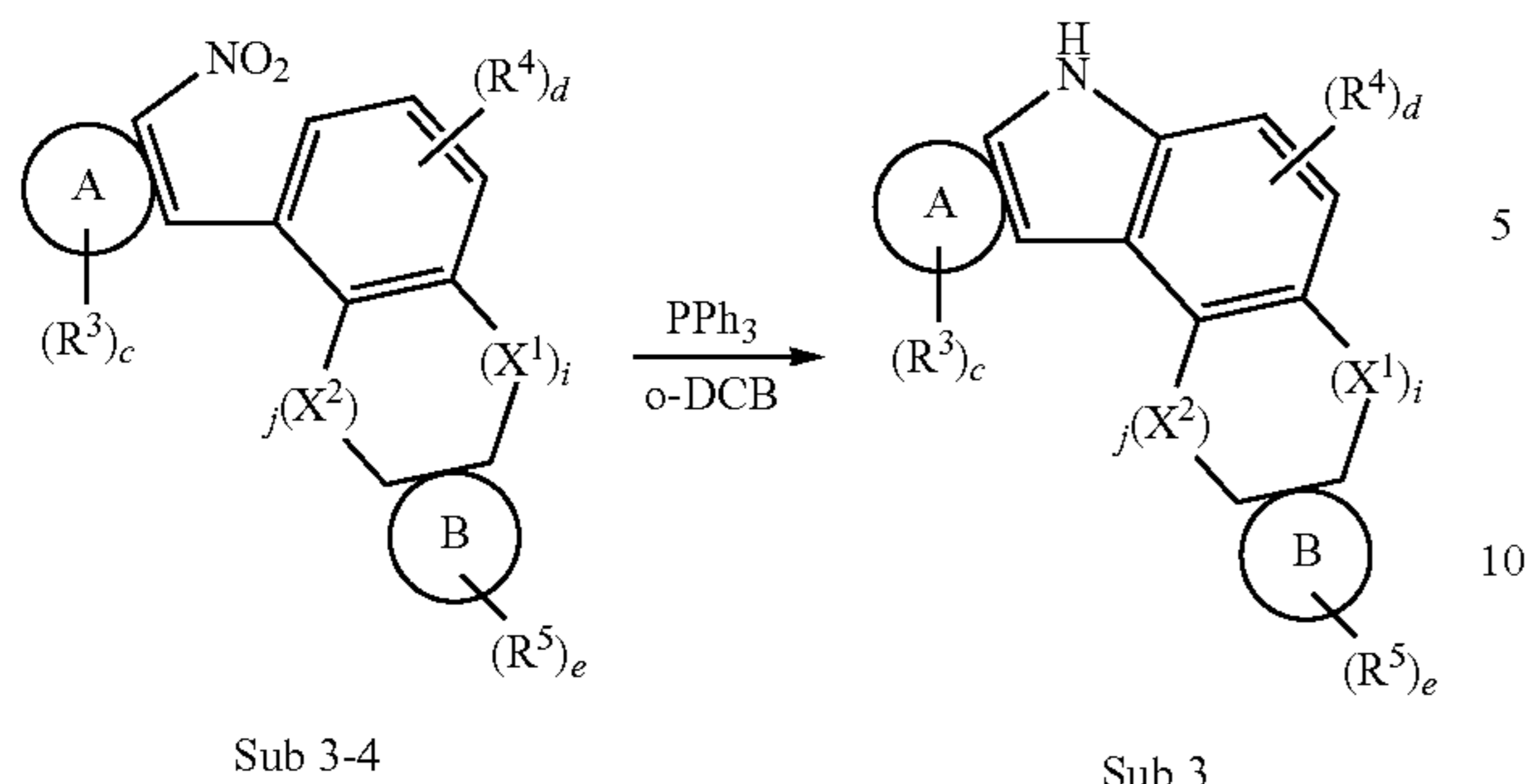
Sub 3 of Reaction Scheme 3 can be synthesized by the reaction path of the following Reaction Scheme 4, but is not limited thereto.

## &lt;Reaction Scheme 4&gt;



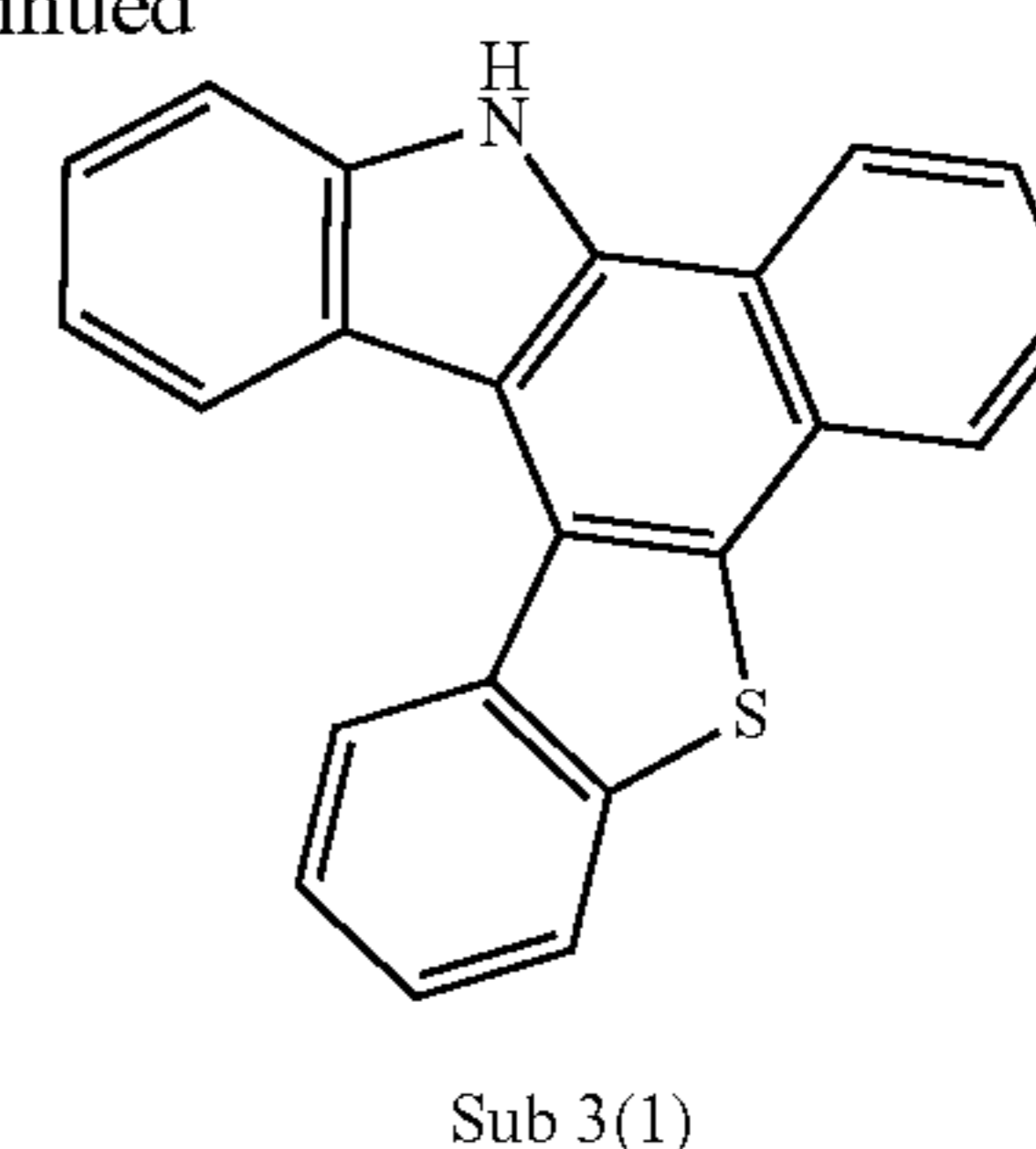
## 115

-continued

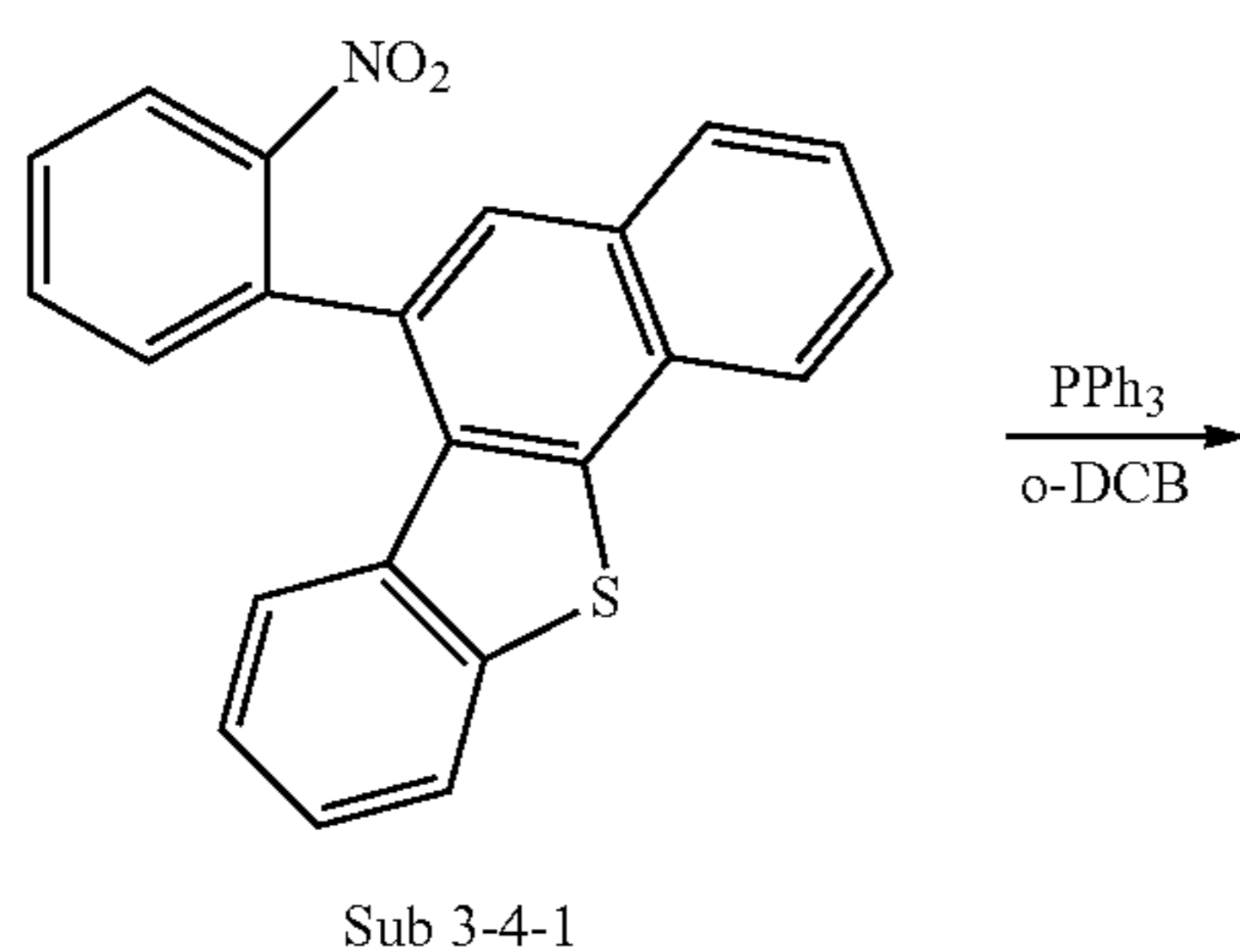
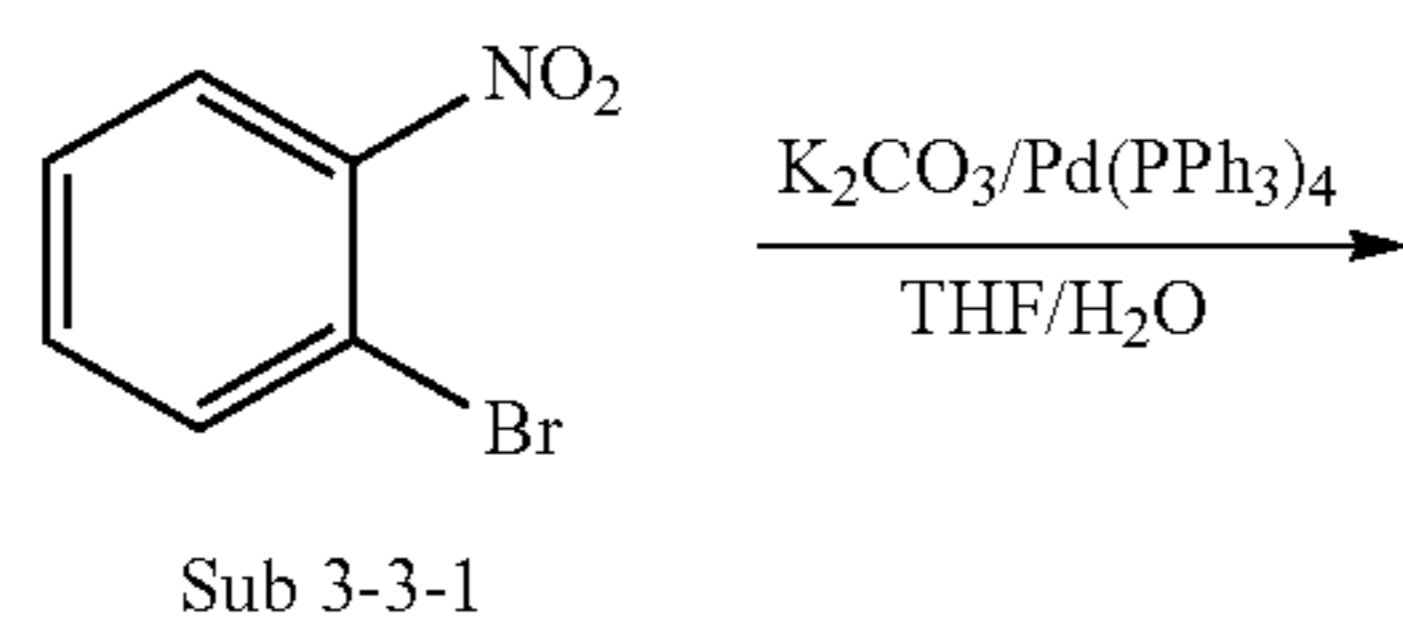
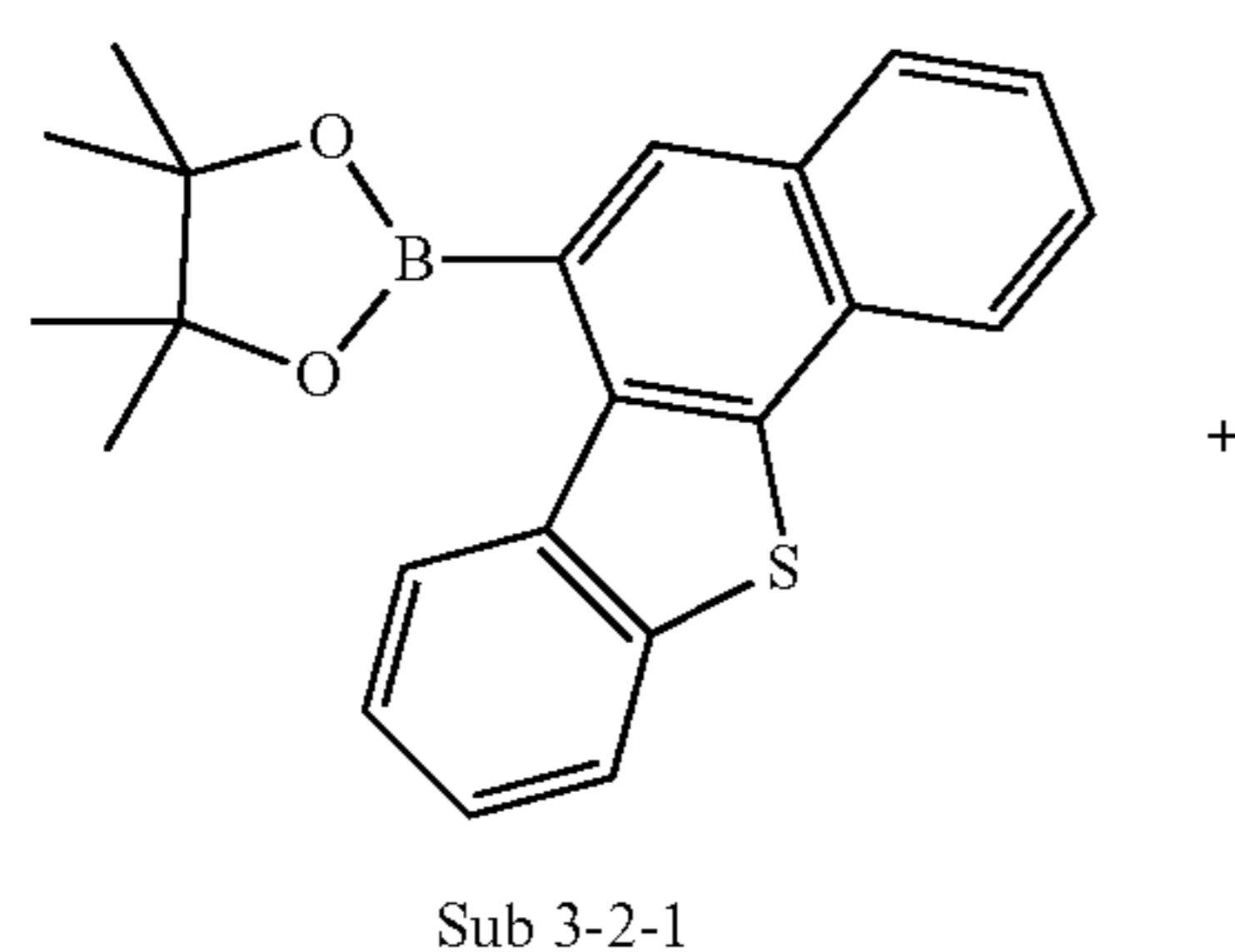
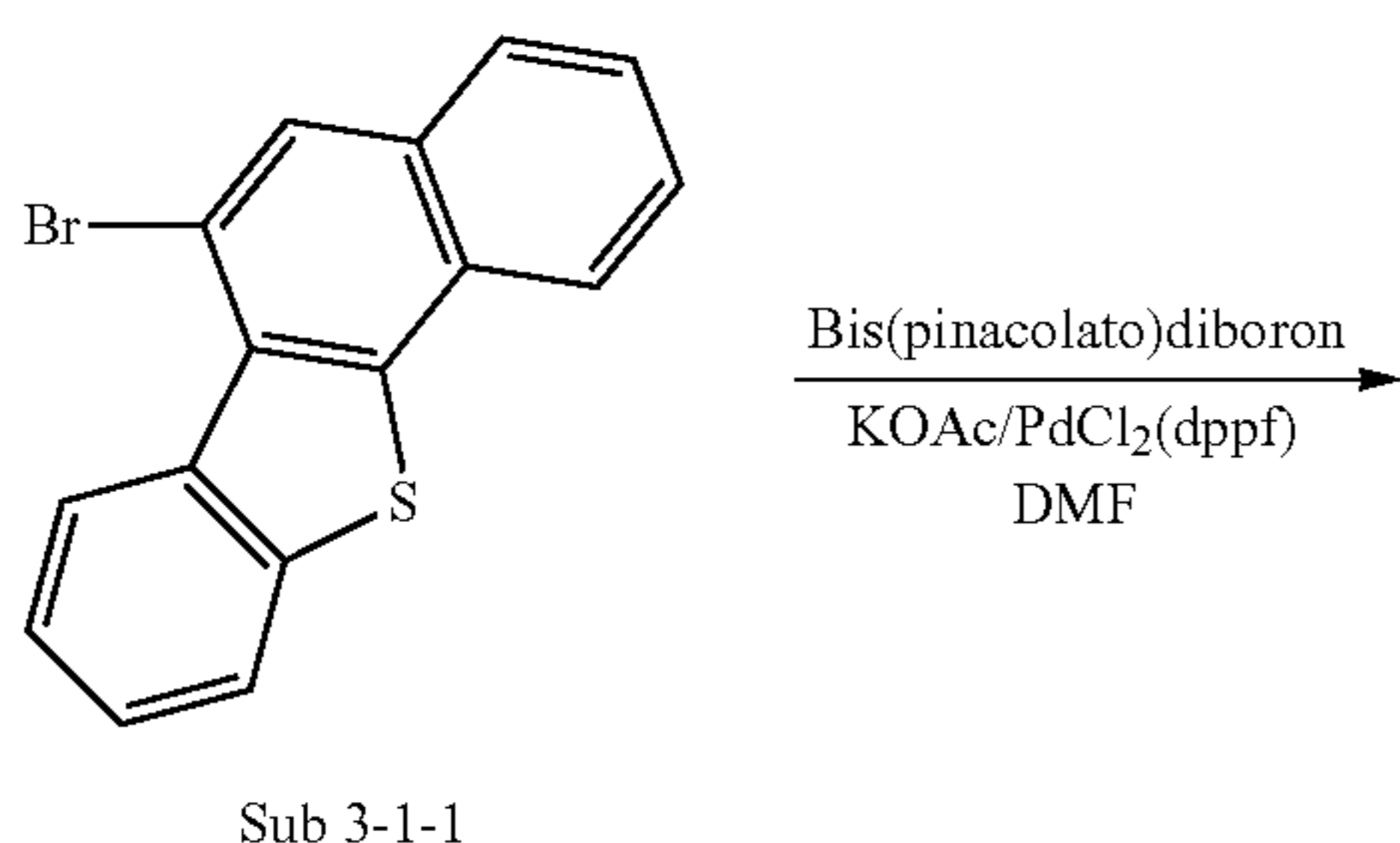


## 116

-continued



## Synthesis Examples of Sub 3(1)



## 15 Synthesis Method of Sub 3-2-1

After Sub 3-1-1 (48.5 g, 155 mmol), bis(pinacolato) diboron (43.4 g, 171 mmol), KOAc (46 g, 466 mmol), PdCl<sub>2</sub>(dppf) (3.8 g, 4.7 mmol) were dissolved in DMF (980 mL), and refluxed at 120° C. for 12 hours. When the reaction was completed, the temperature of the reaction was cooled to room temperature, extracted with CH<sub>2</sub>Cl<sub>2</sub> and wiped with water. The organic layer was dried over MgSO<sub>4</sub> and concentrated. The resulting compound was recrystallized by CH<sub>2</sub>Cl<sub>2</sub> and methanol solvent to obtain Sub 3-2-1. (41.9 g, 75%)

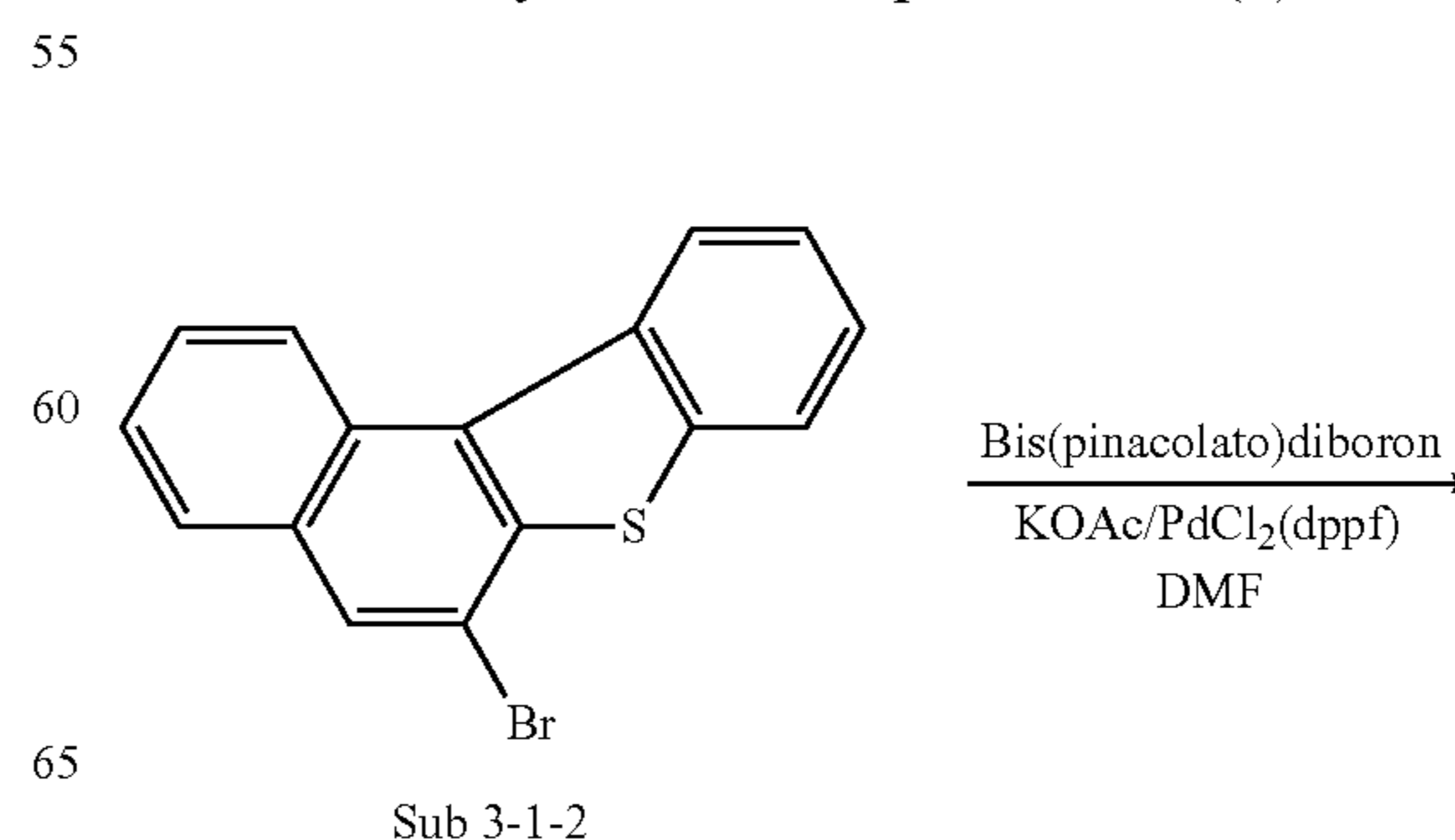
## 30 Synthesis Method of Sub 3-4-1

Sub 3-2-1 (40.0 g, 111 mmol), bromo-2-nitrobenzene (26.91 g, 133 mmol), K<sub>2</sub>CO<sub>3</sub> (46.03 g, 333 mmol), Pd(PPh<sub>3</sub>)<sub>4</sub> (7.7 g, 6.66 mmol) were added in a round bottom flask and THF (490 mL) and water (245 mL) were added to dissolve and refluxed at 80° C. for 12 hours. When the reaction was completed, the temperature of the reaction was cooled to room temperature, extracted with CH<sub>2</sub>Cl<sub>2</sub> and wiped with water. The organic layer was dried over MgSO<sub>4</sub> and concentrated. The resulting compound was separated by silicagel column chromatography to obtain Sub 3-4-1. (30.8 g, 78%)

## 45 Synthesis Method of Sub 3(1)

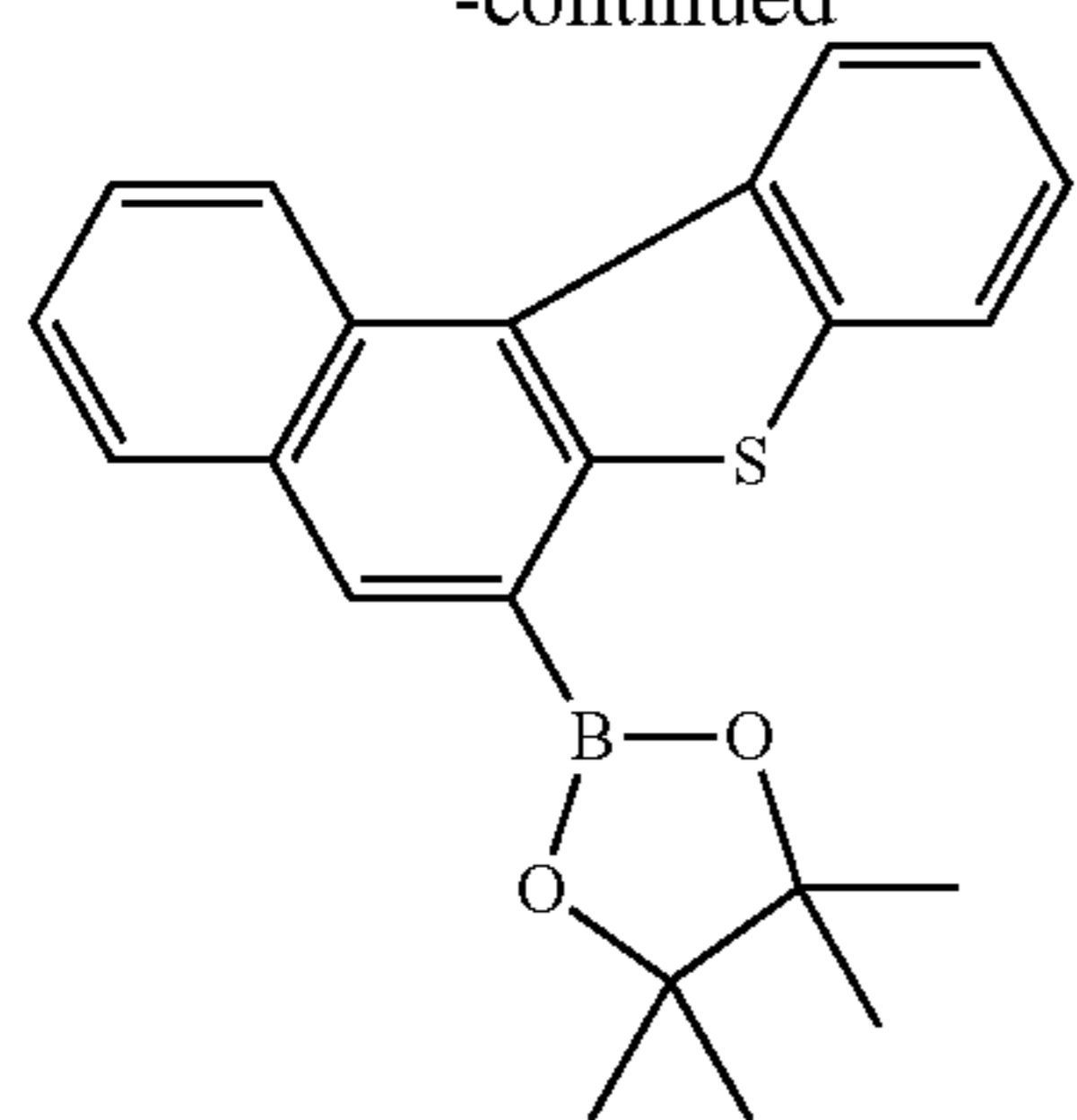
Sub 3-4-1 (20 g, 56.3 mmol) and triphenylphosphine (37 g, 141 mmol) were dissolved in o-dichlorobenzene (235 mL) and refluxed for 24 hours. When the reaction was completed, the solvent was removed using reduced pressure distillation. The resulting compound was separated by silicagel column chromatography and recrystallized to obtain Sub 3(1). (14.4 g, 79%)

## 55 Synthesis Example of Sub 3(2)

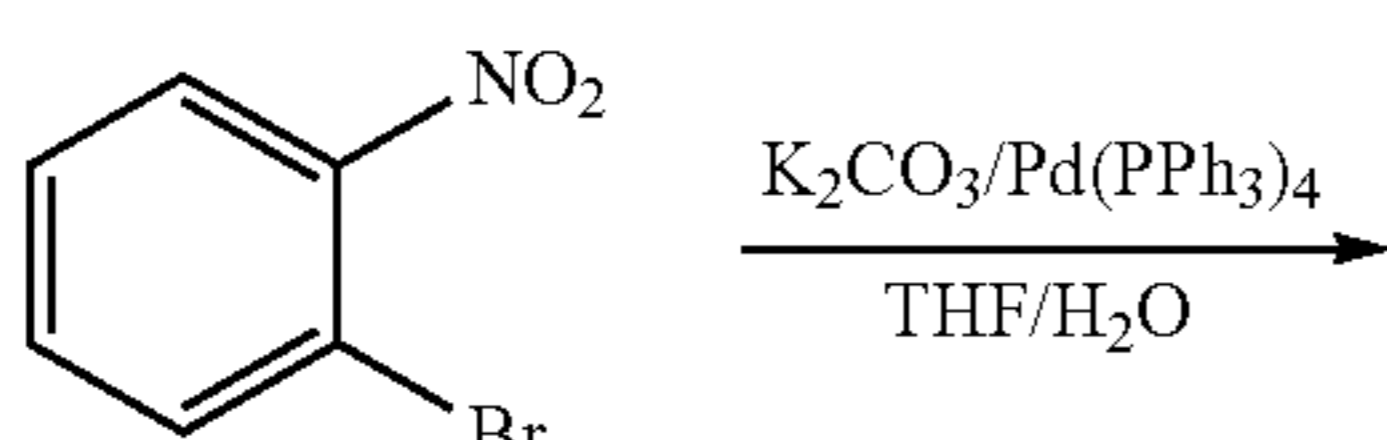


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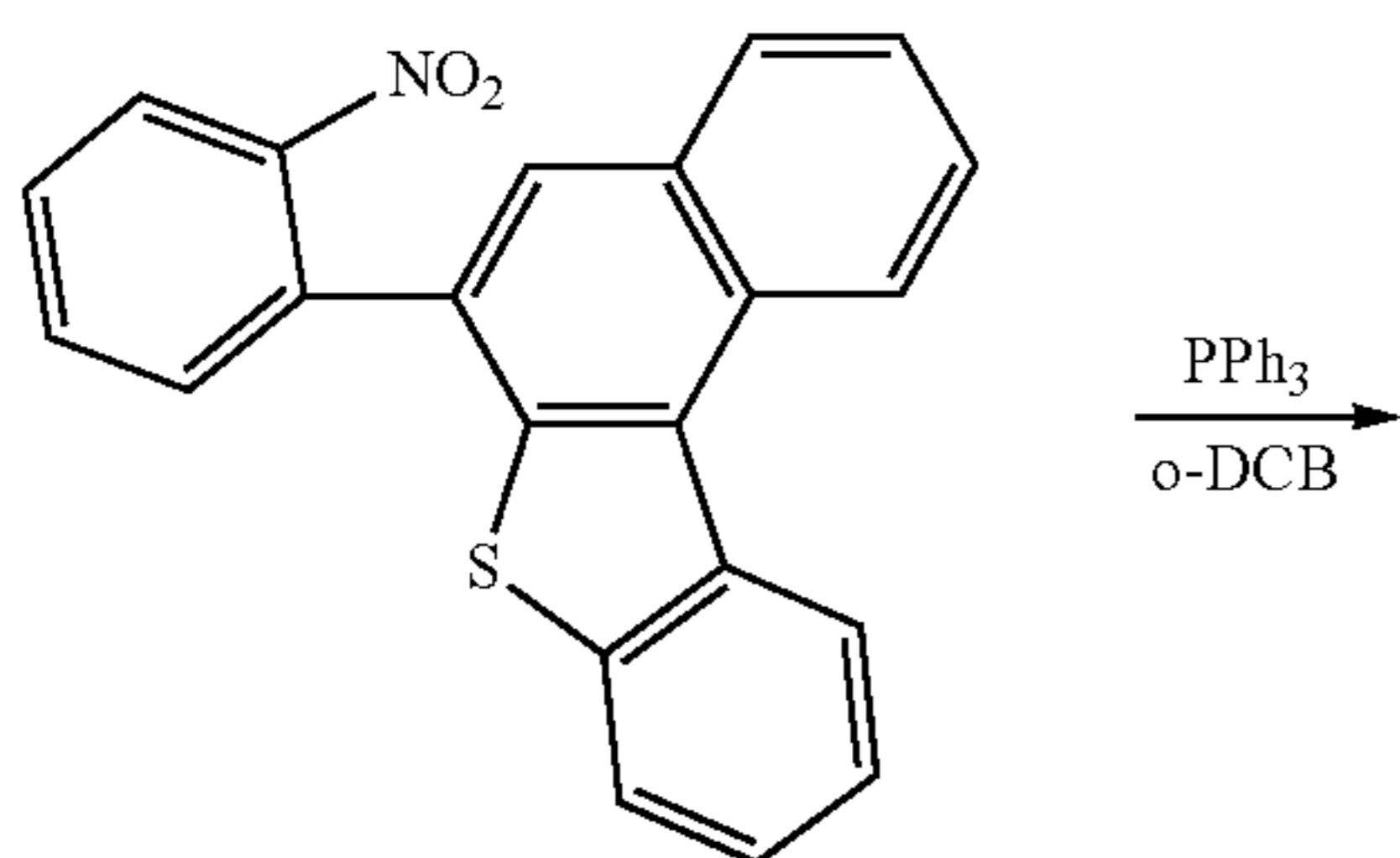
-continued



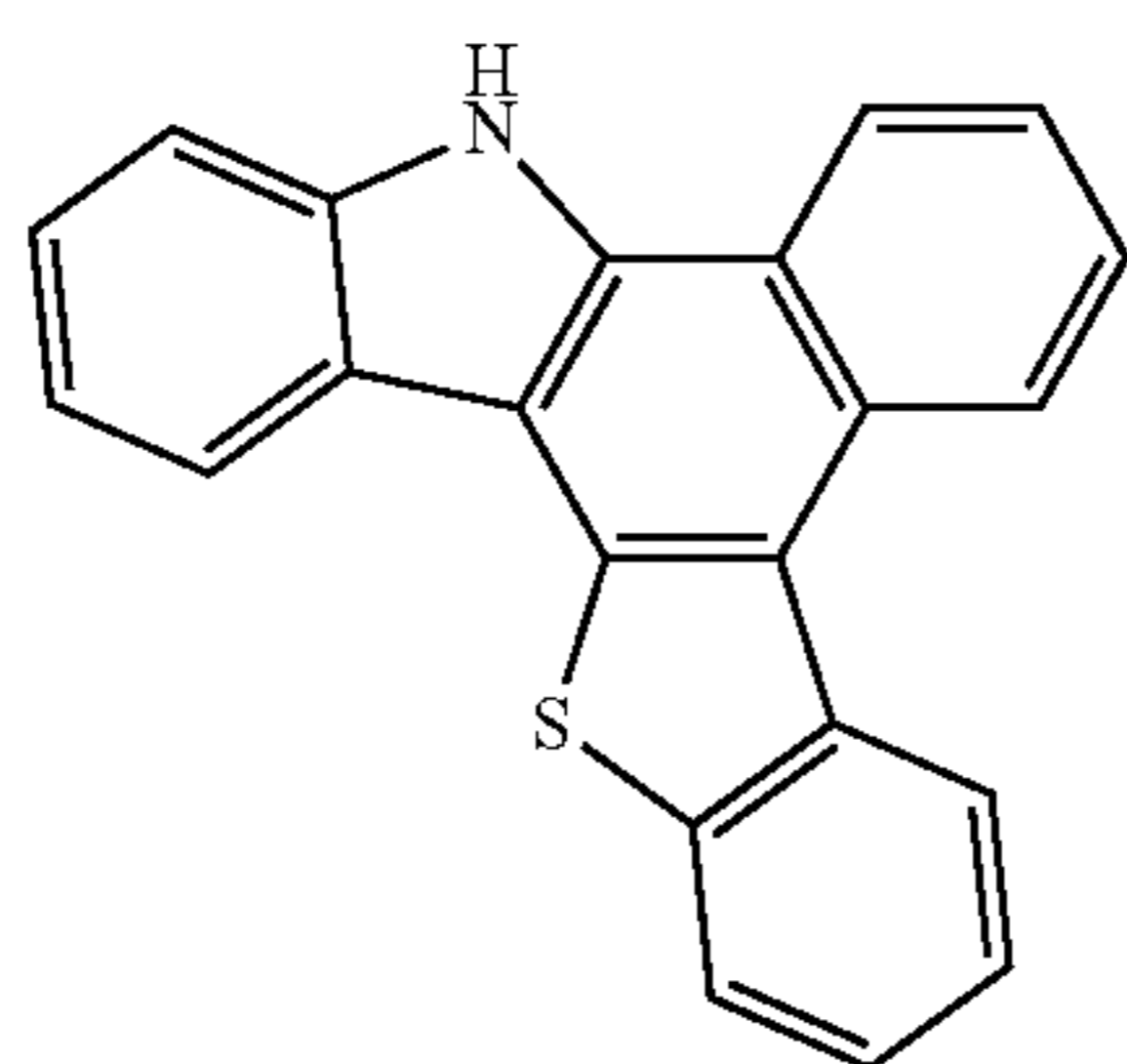
Sub 3-2-2



Sub 3-3



Sub 3-4-2



Sub 3(2)

## Synthesis Method of Sub 3-2-2

Sub 3-1-2 (48.5 g, 155 mmol) was carried out in the same manner as in Sub 3-2-1 to give the product Sub 3-2-2 (44.7 g, 80%).

## Synthesis Method of Sub 3-4-2

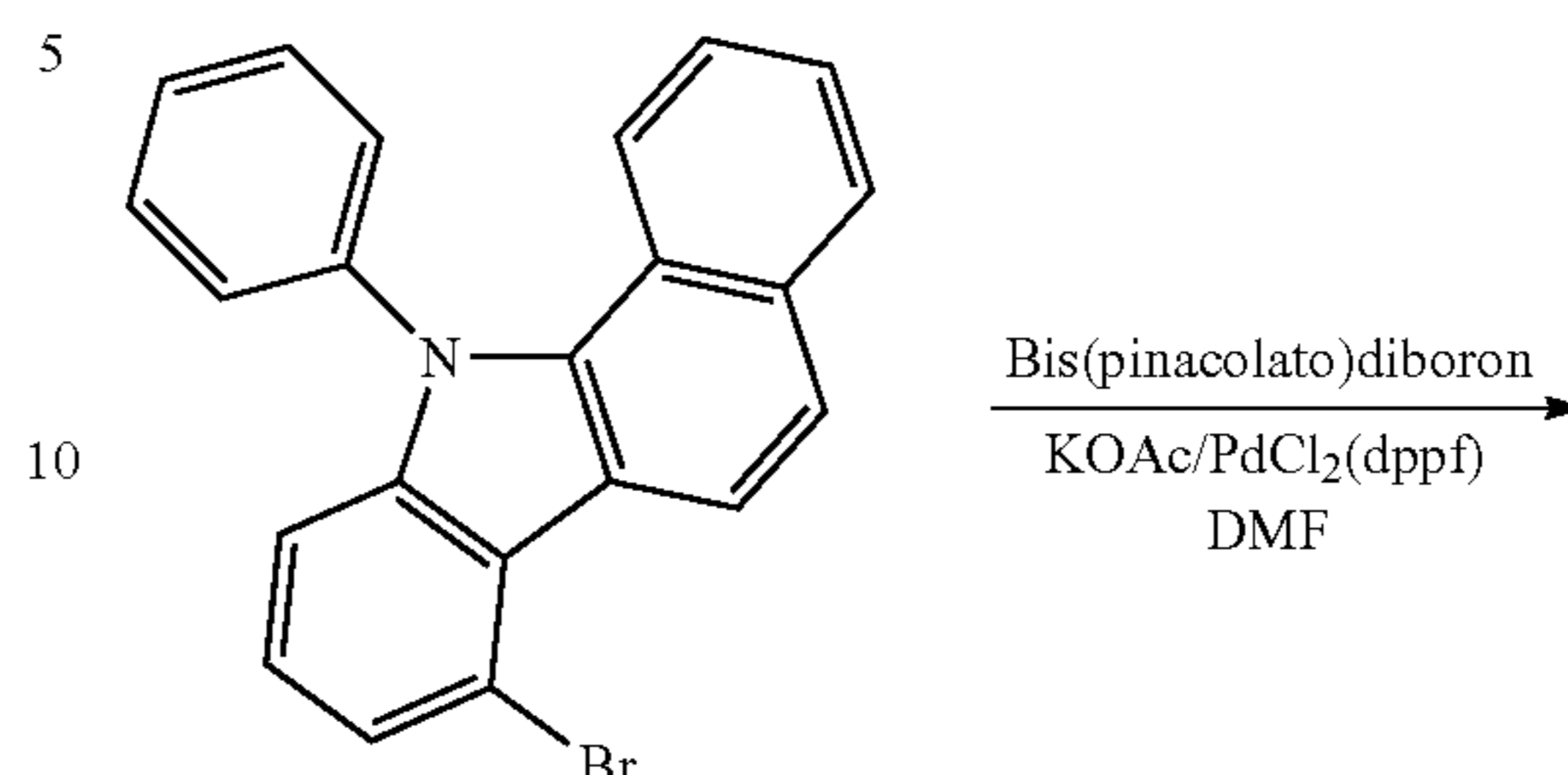
Sub 3-2-2 (40.0 g, 111 mmol) was carried out in the same manner as in Sub 3-4-1 to give the product Sub 3-4-2 (31.2 g, 79%).

## Synthesis Method of Sub 3(2)

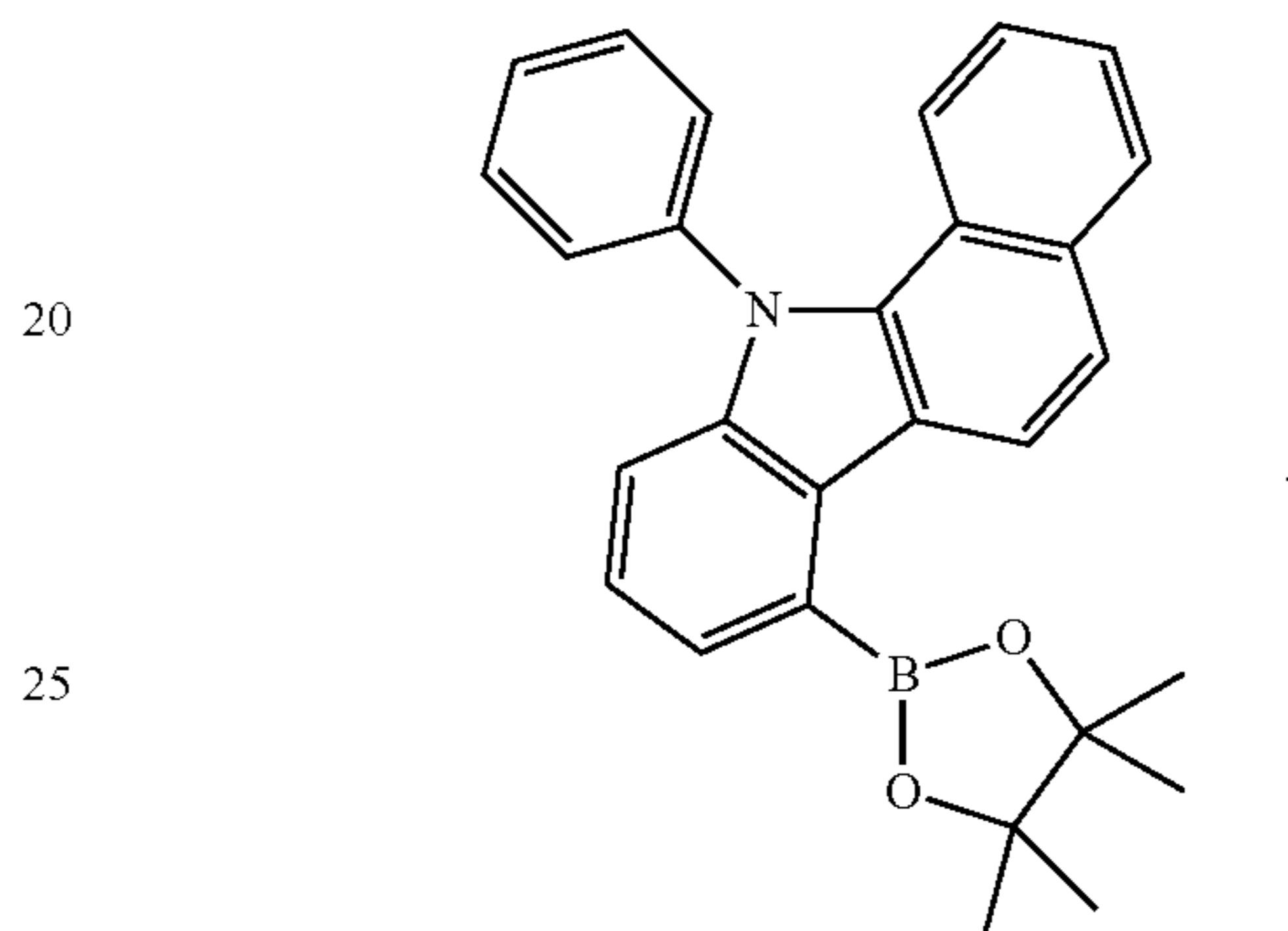
Sub 3-4-2 (20 g, 56.3 mmol) was carried out in the same manner as in Sub 3(1) to give the product Sub 3(2) (14.9 g, 82%).

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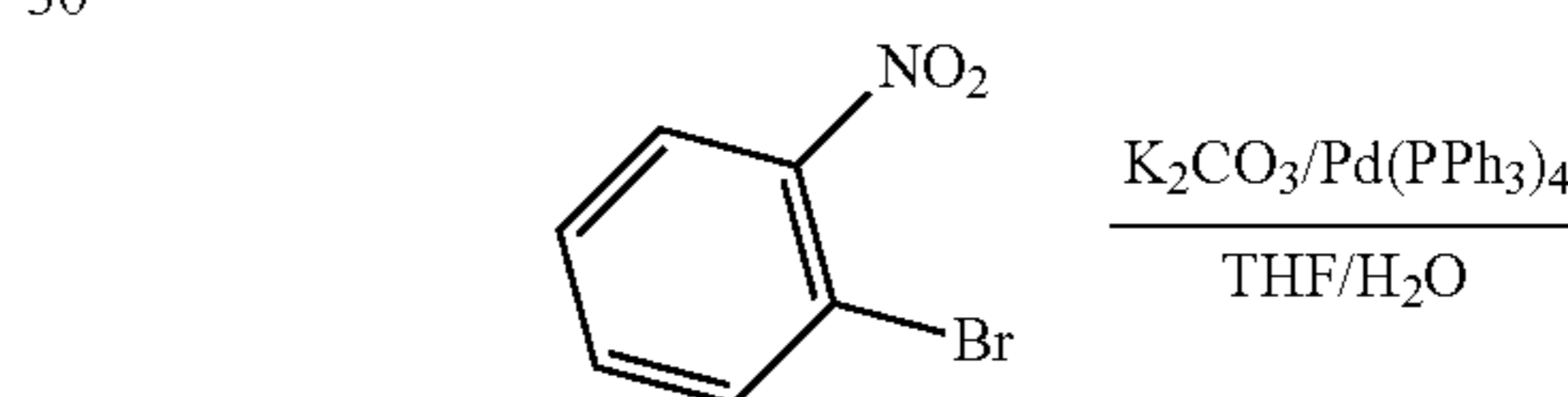
Synthesis Example of Sub 3(7)



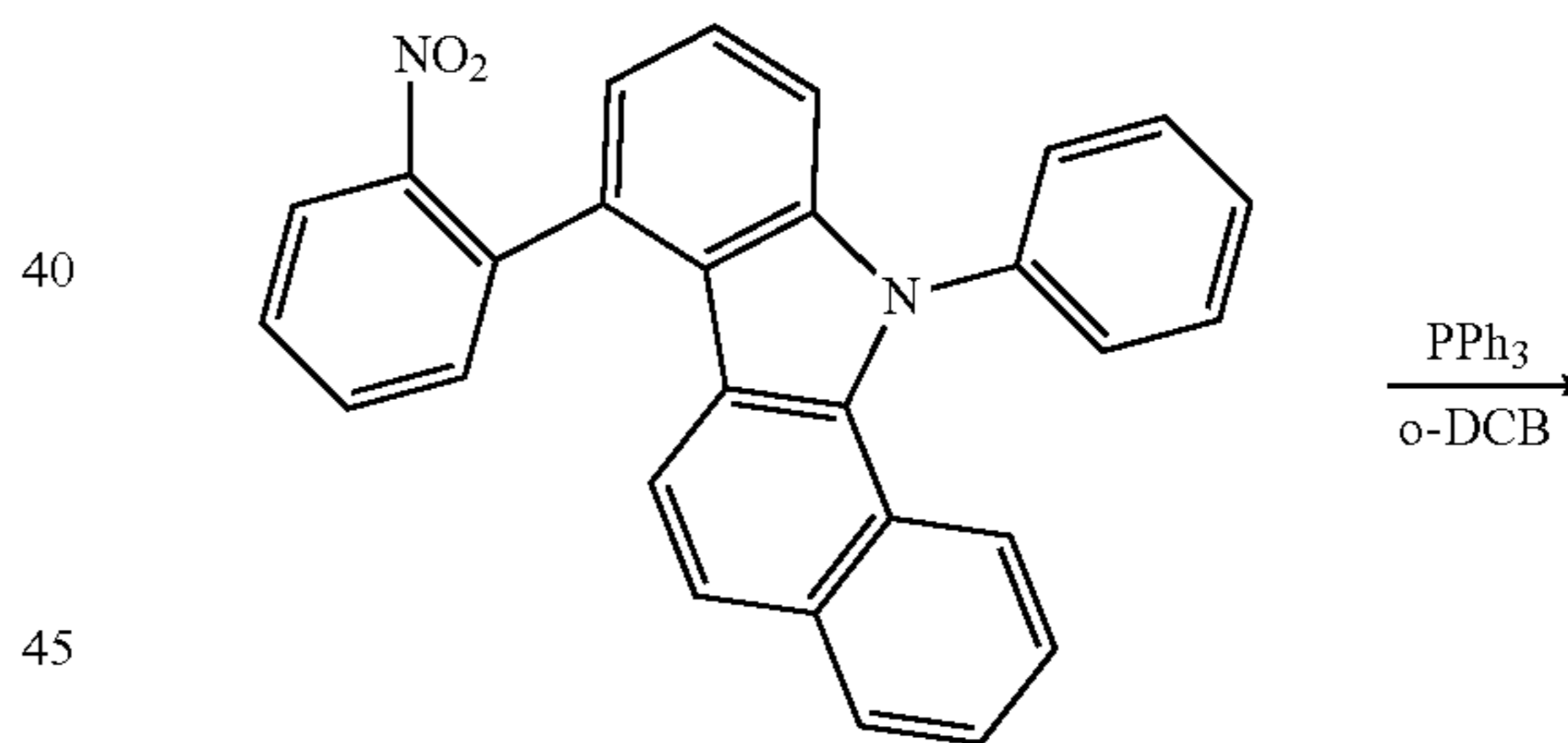
Sub 3-1-3



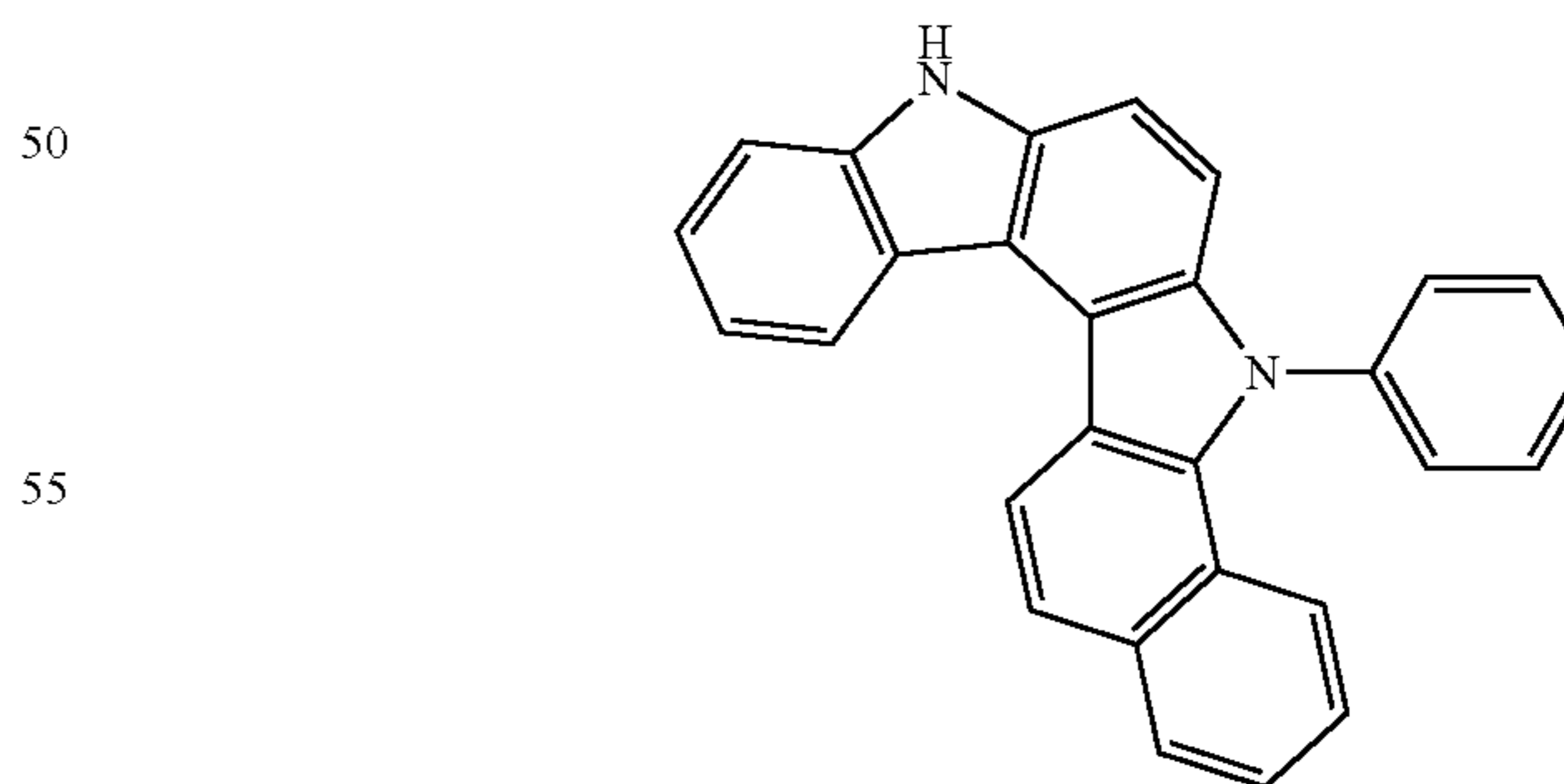
Sub 3-2-3



Sub 3-3



Sub 3-4-3



Sub 3(7)

## Synthesis Method of Sub 3-2-3

Sub 3-1-3 (57.7 g, 155 mmol) was carried out in the same manner as in Sub 3-2-1 to give the product Sub 3-2-3 (49.4 g, 76%).

## 119

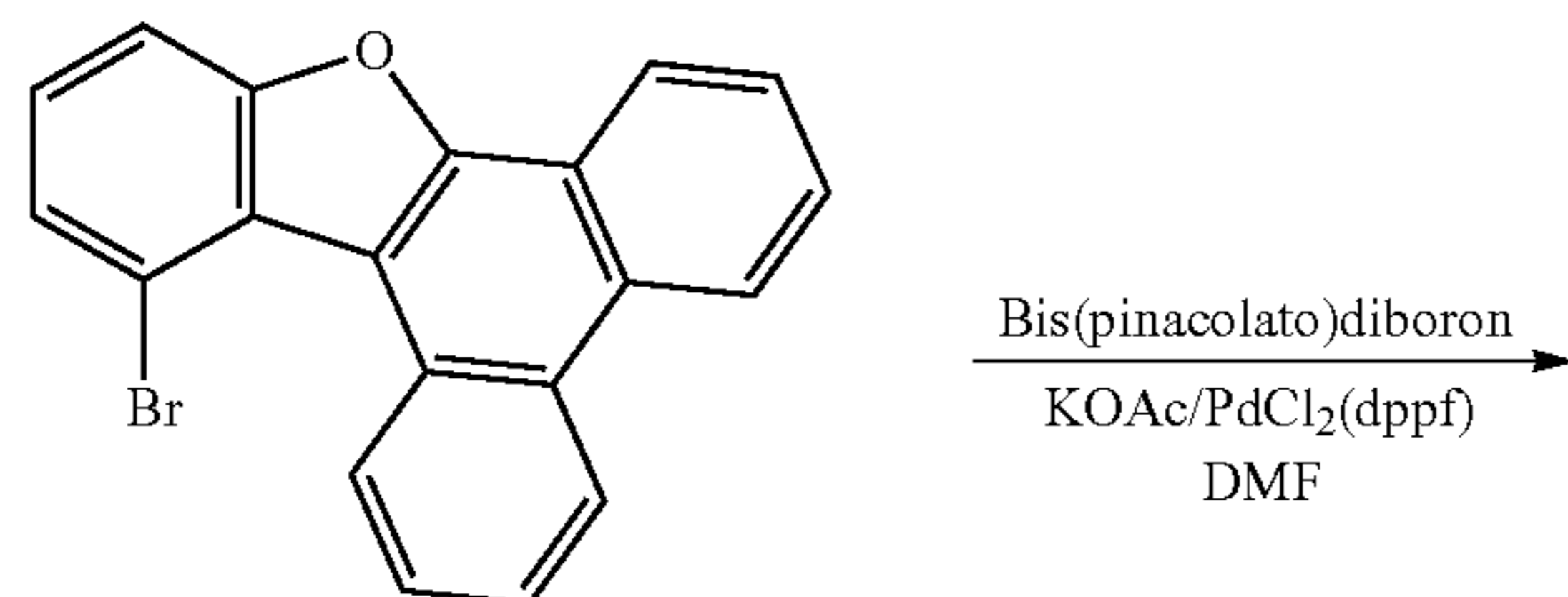
## Synthesis Method of Sub 3-4-3

Sub 3-2-3 (46.5 g, 111 mmol) was carried out in the same manner as in Sub 3-4-1 to give the product Sub 3-4-3 (35.9 g, 79%).

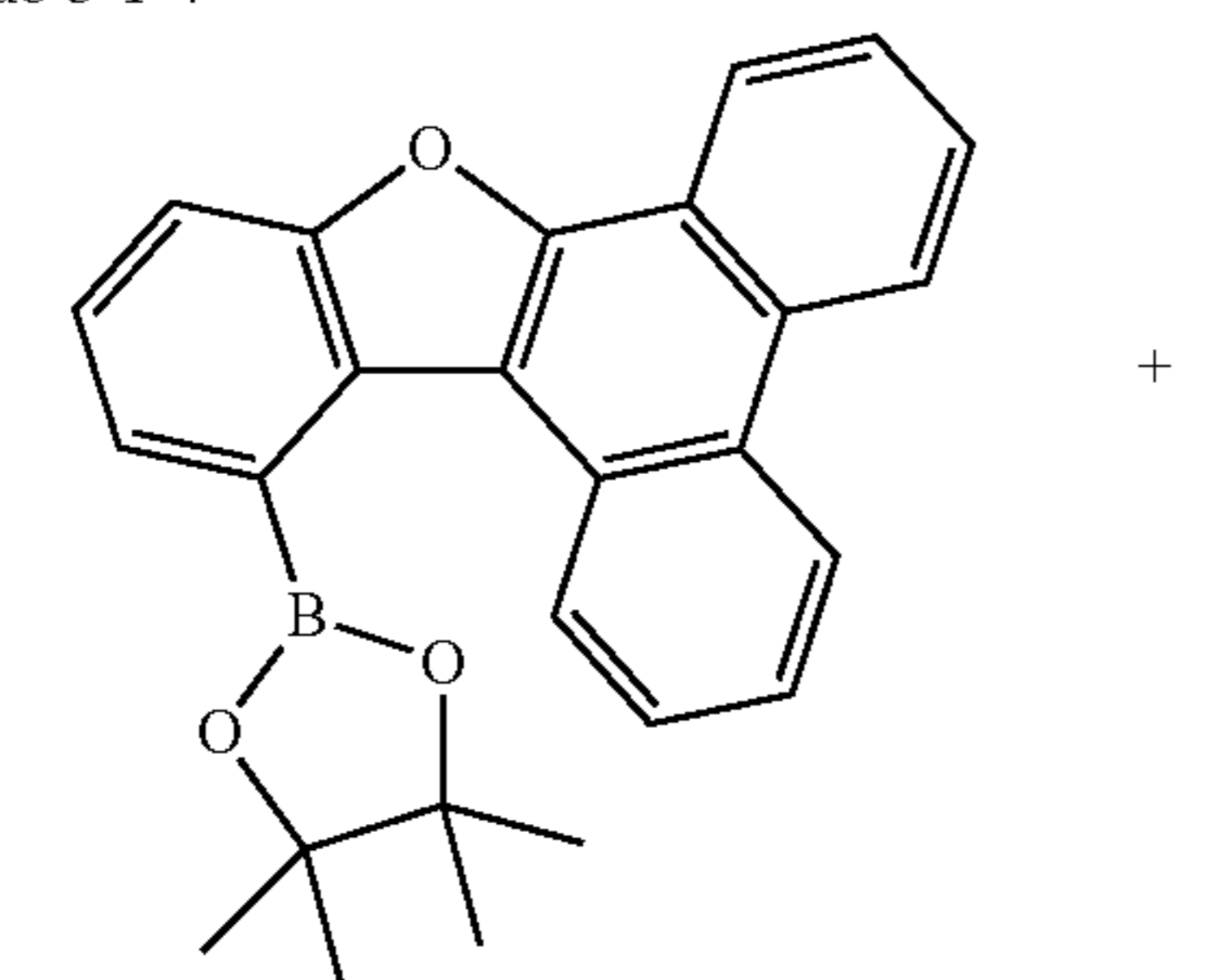
## Synthesis Method of Sub 3(7)

Sub 3-4-3 (23.3 g, 56.3 mmol) was carried out in the same manner as in Sub 3(1) to give the product Sub 3(7) (17.2 g, 82%).

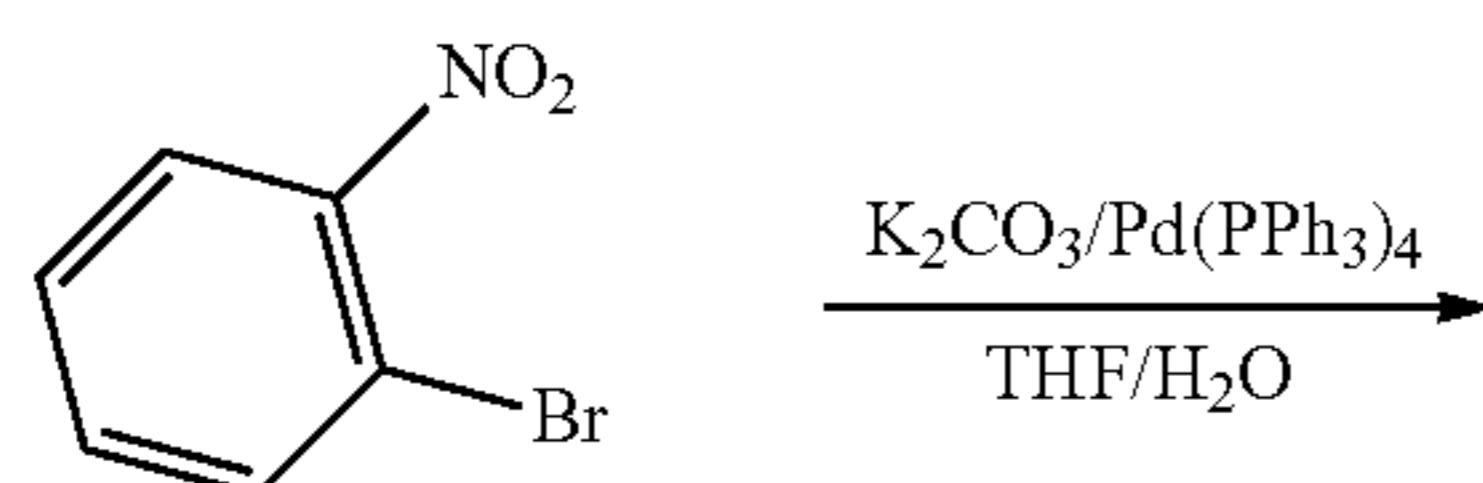
## Synthesis Example of Sub 3(13)



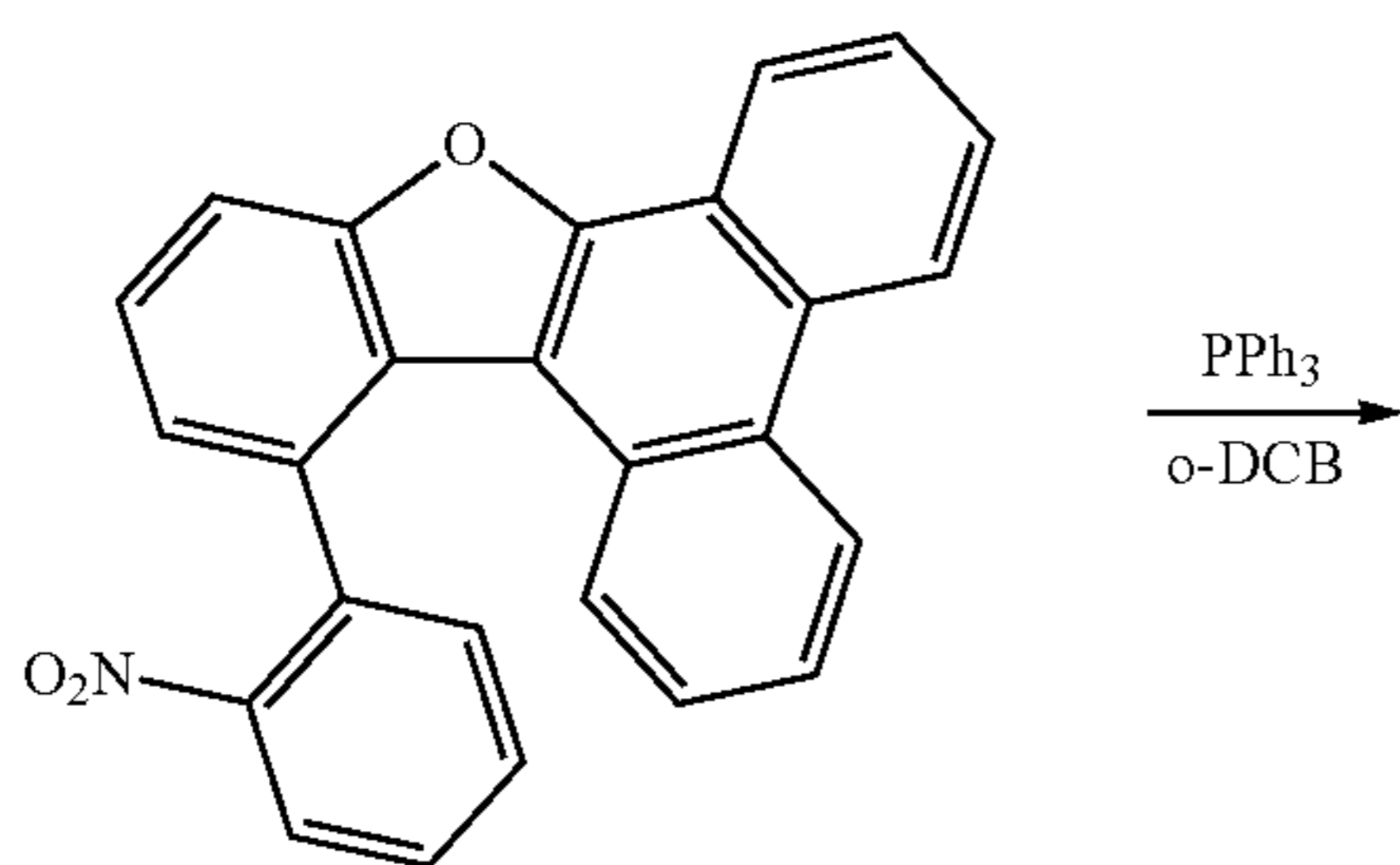
Sub 3-1-4



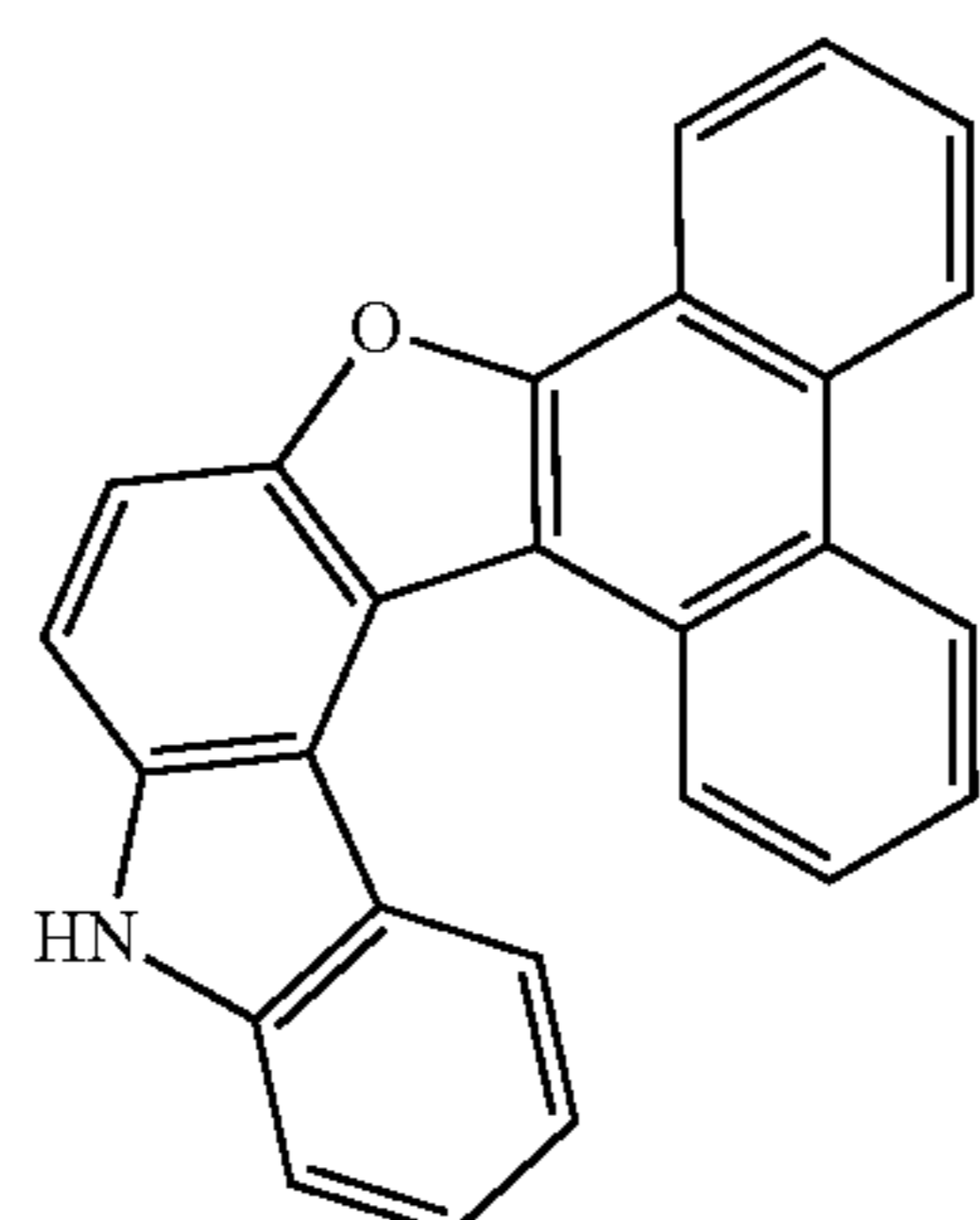
Sub 3-2-4



Sub 3-3



Sub 3-4-4



Sub 3(13)

## 120

## Synthesis Method of Sub 3-2-4

Sub 3-1-4 (53.8 g, 155 mmol) was carried out in the same manner as in Sub 3-2-1 to give the product Sub 3-2-4 (45.2 g, 74%).

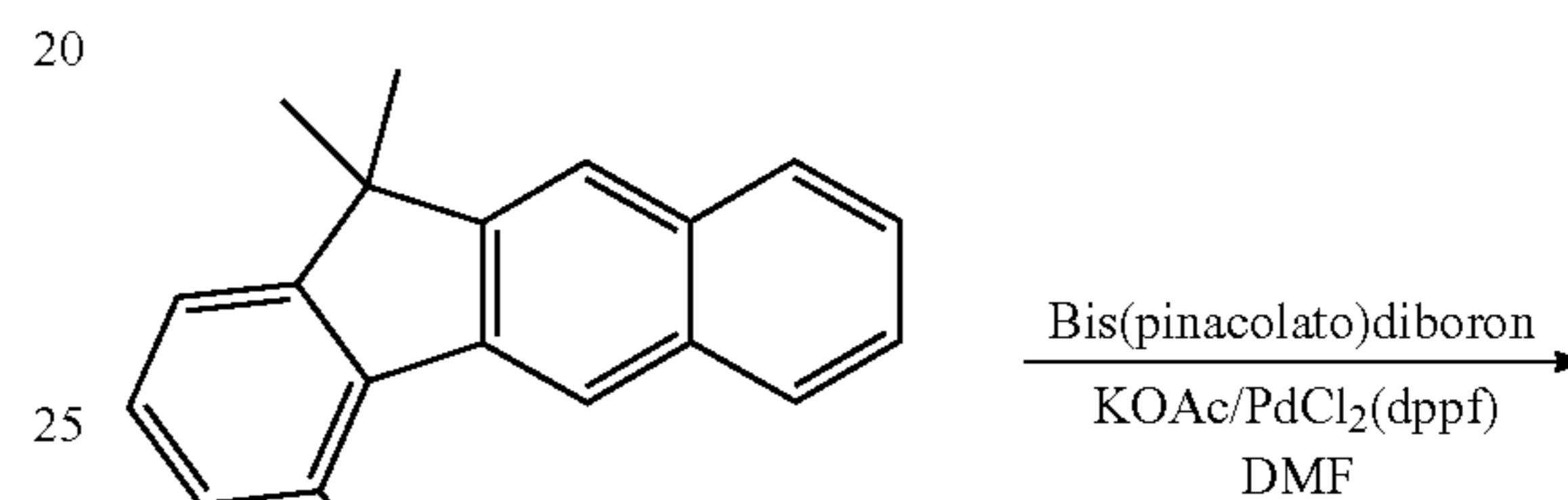
## Synthesis Method of Sub 3-4-4

Sub 3-2-4 (43.8 g, 111 mmol) was carried out in the same manner as in Sub 3-4-1 to give the product Sub 3-4-4 (33.7 g, 78%).

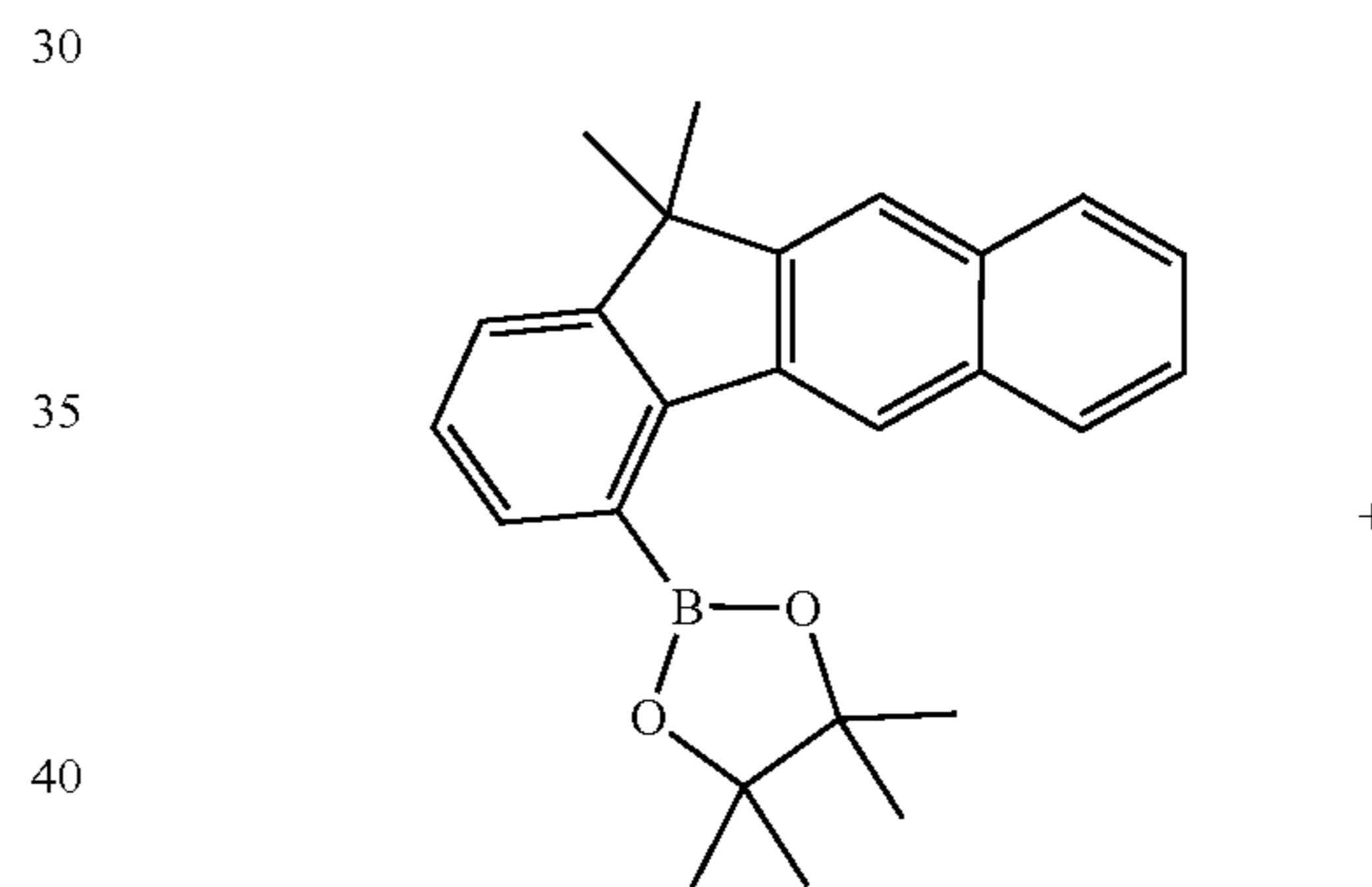
## Synthesis Method of Sub 3(13)

Sub 3-4-4 (21.9 g, 56.3 mmol) was carried out in the same manner as in Sub 3(1) to give the product Sub 3(13) (16.1 g, 80%).

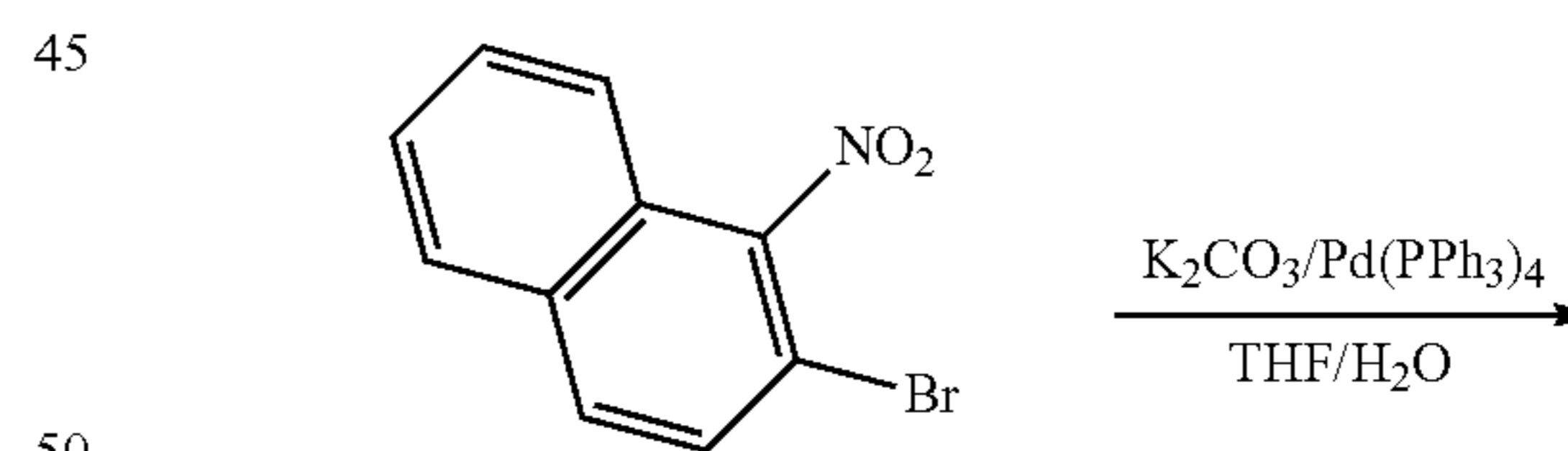
## Synthesis Example of Sub 3(26)



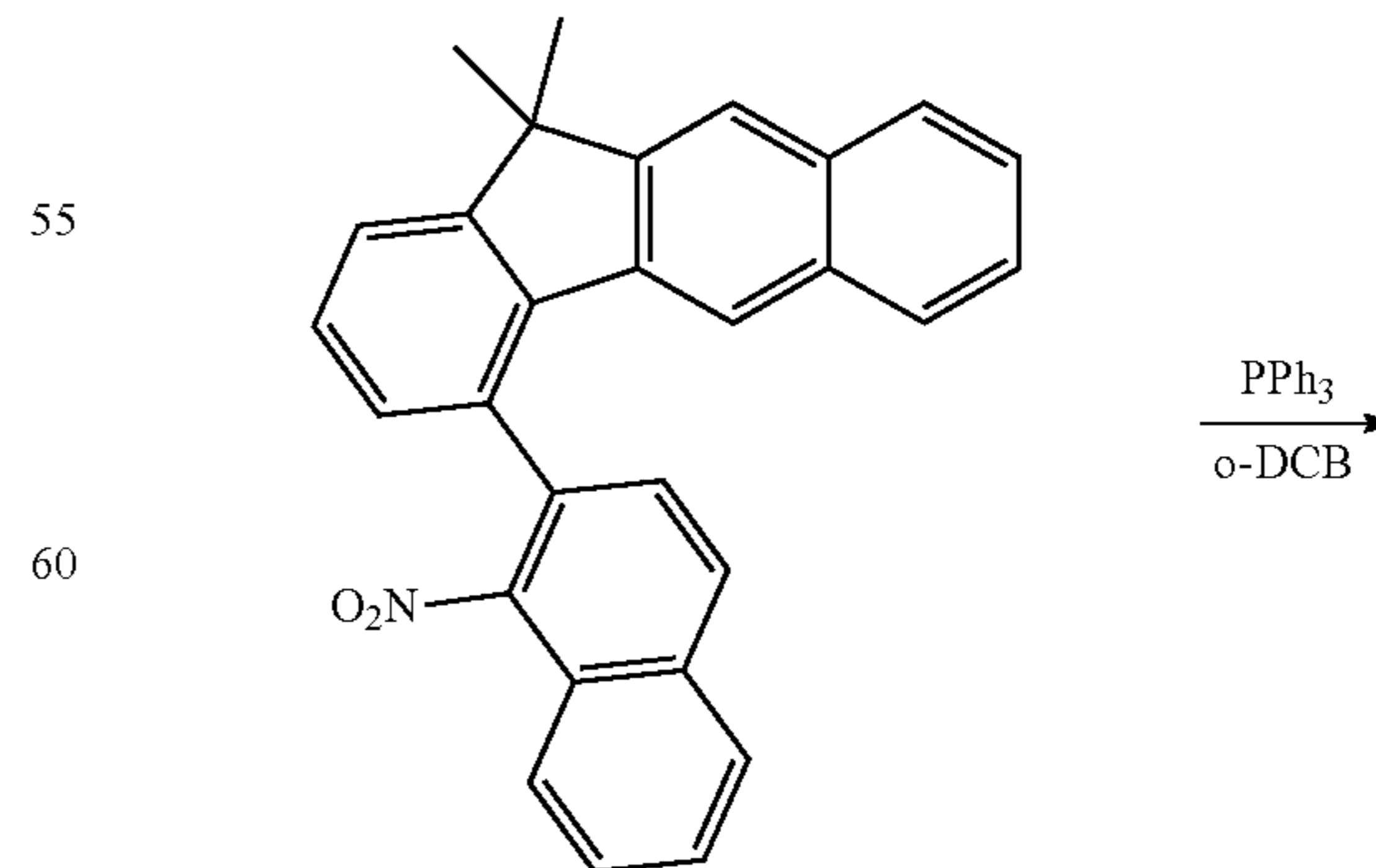
Sub 3-1-5



Sub 3-2-5



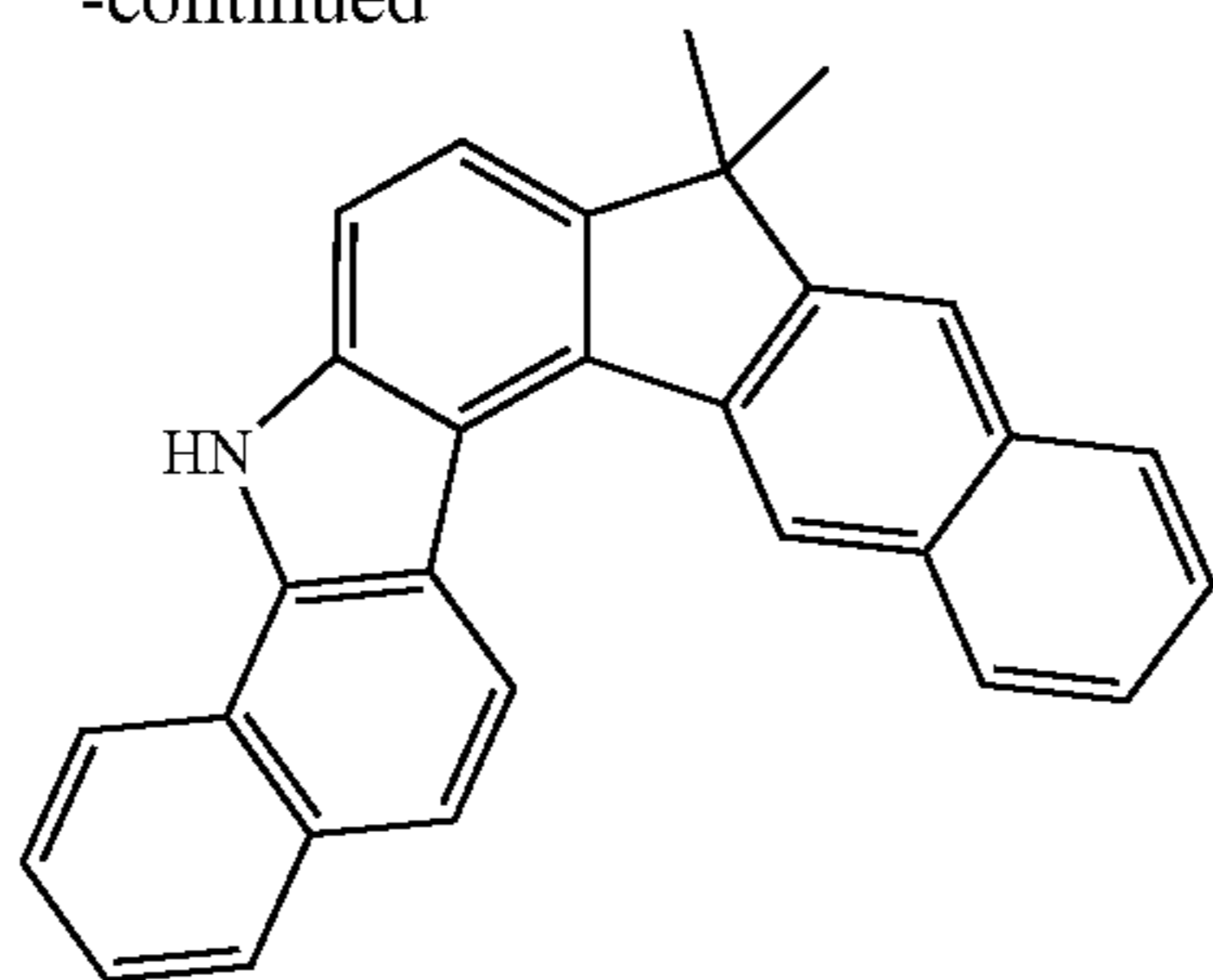
Sub 3-3-1



Sub 3-4-5

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-continued



Sub 3(26)

Synthesis Method of Sub 3-2-5

Sub 3-1-5 (50.1 g, 155 mmol) was carried out in the same manner as in Sub 3-2-1 to give the product Sub 3-2-5 (43.6 g, 76%).

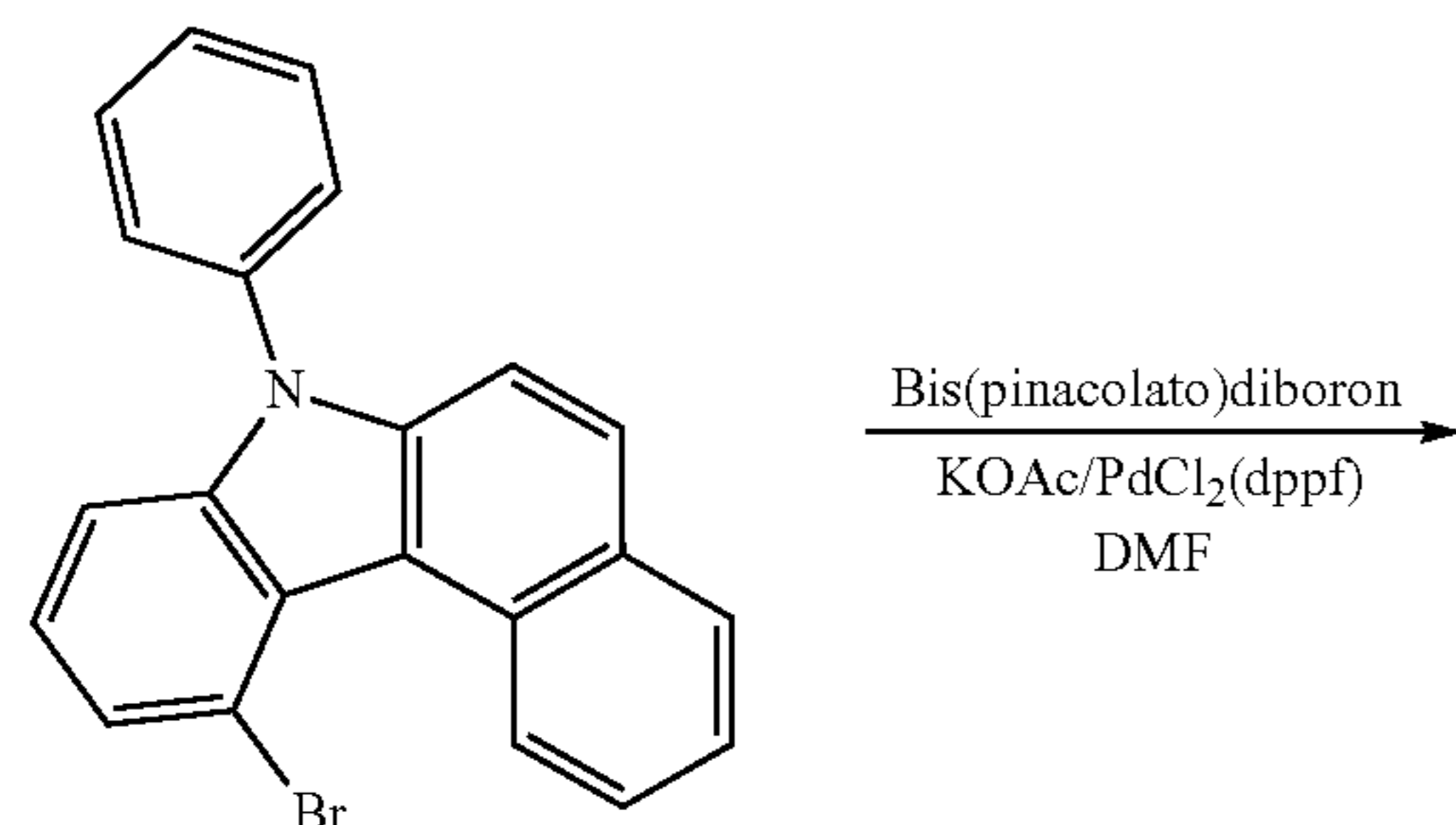
Synthesis Method of Sub 3-4-5

Sub 3-2-5 (41.1 g, 111 mmol) and Sub 3-3-1 (33.5 g, 133 mmol) were carried out in the same manner as in Sub 3-4-1 to give the product Sub 3-4-5 (36.9 g, 80%).

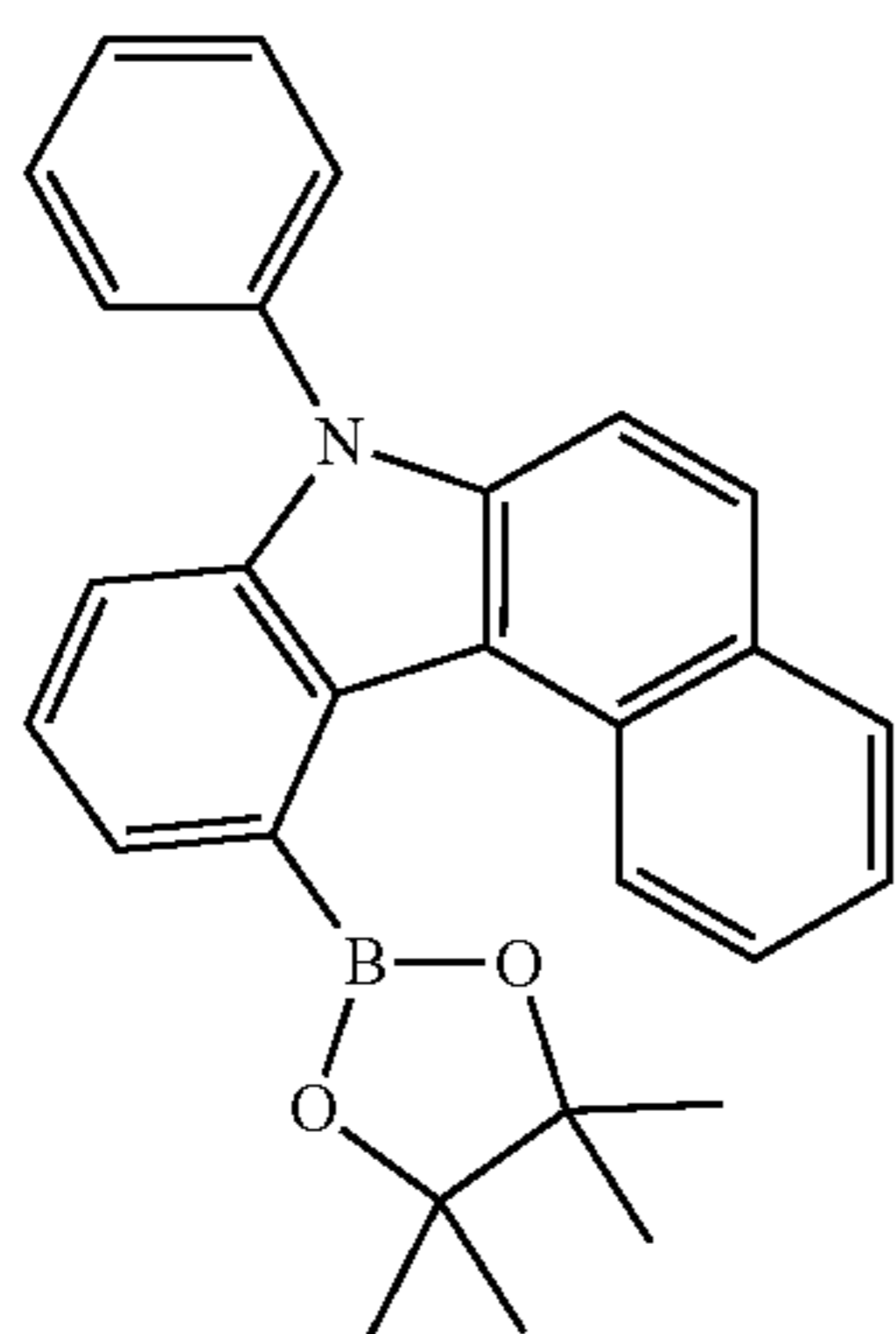
Synthesis Method of Sub 3(26)

Sub 3-4-5 (23.4 g, 56.3 mmol) was carried out in the same manner as in Sub 3(1) to give the product Sub 3(26) (17.5 g, 80%).

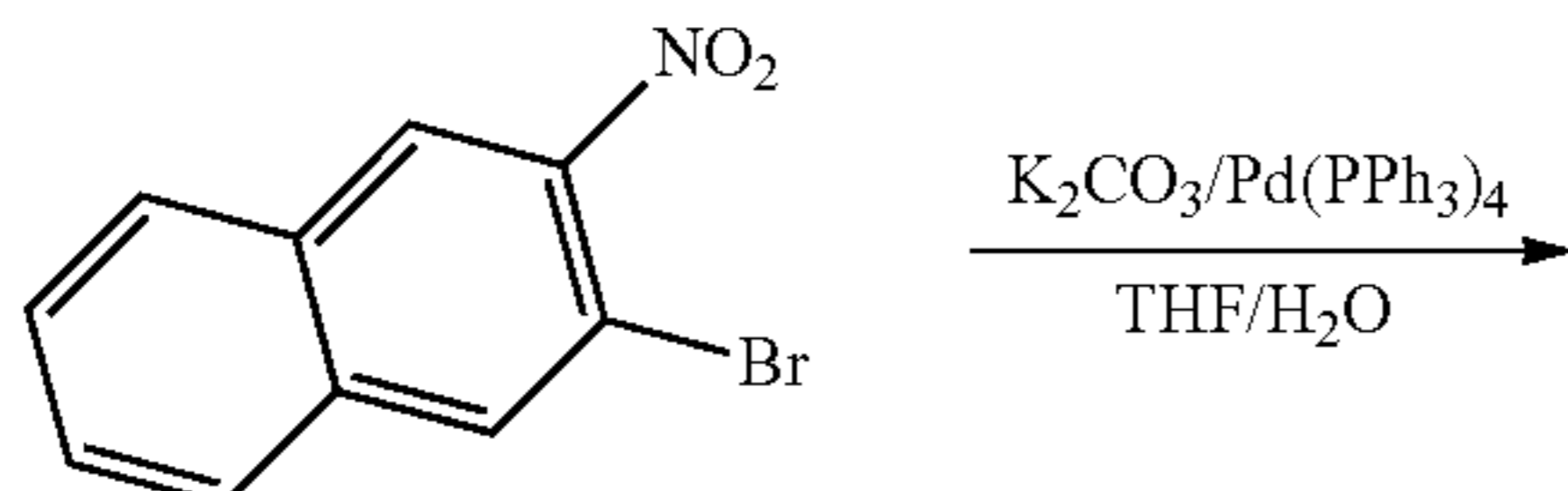
Synthesis Example of Sub 3(39)



Sub 3-1-6



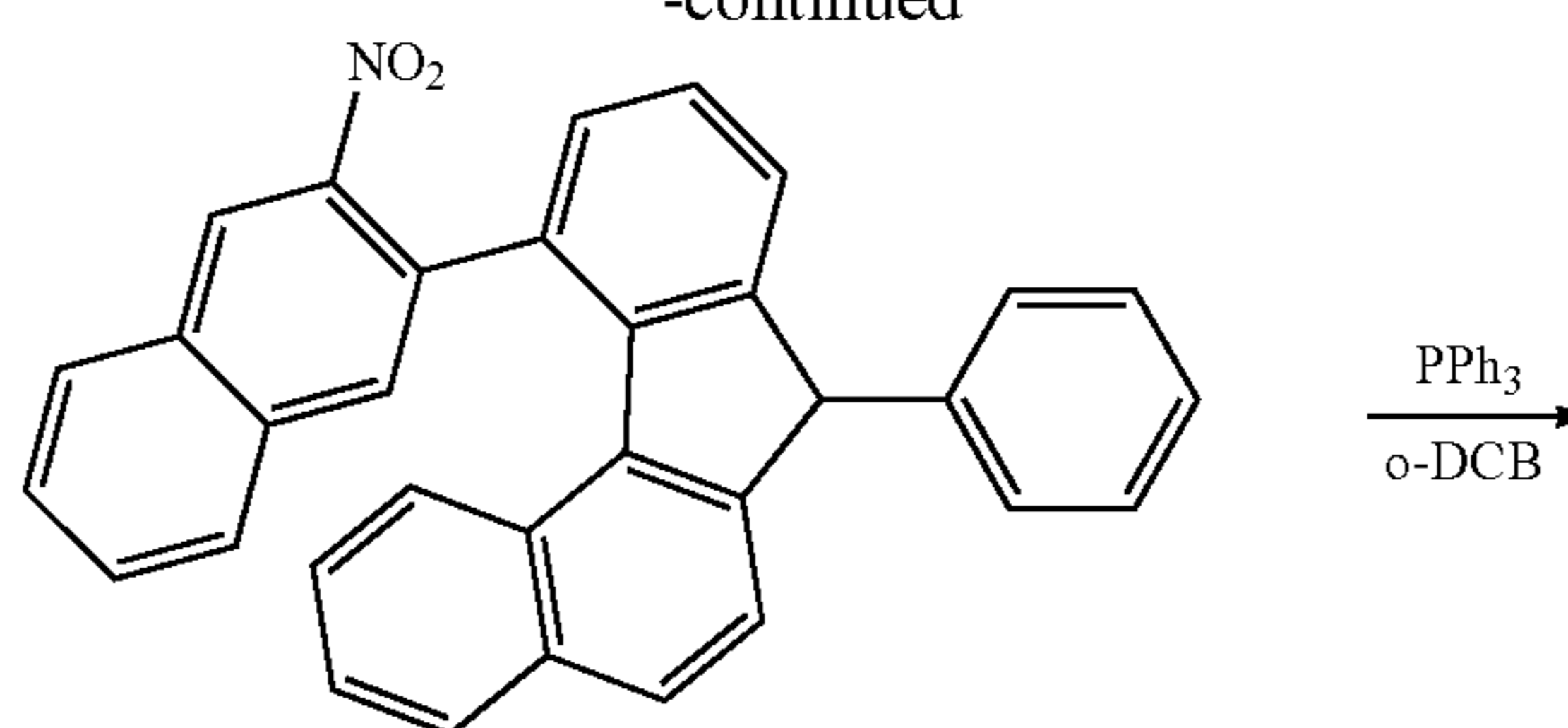
Sub 3-2-6



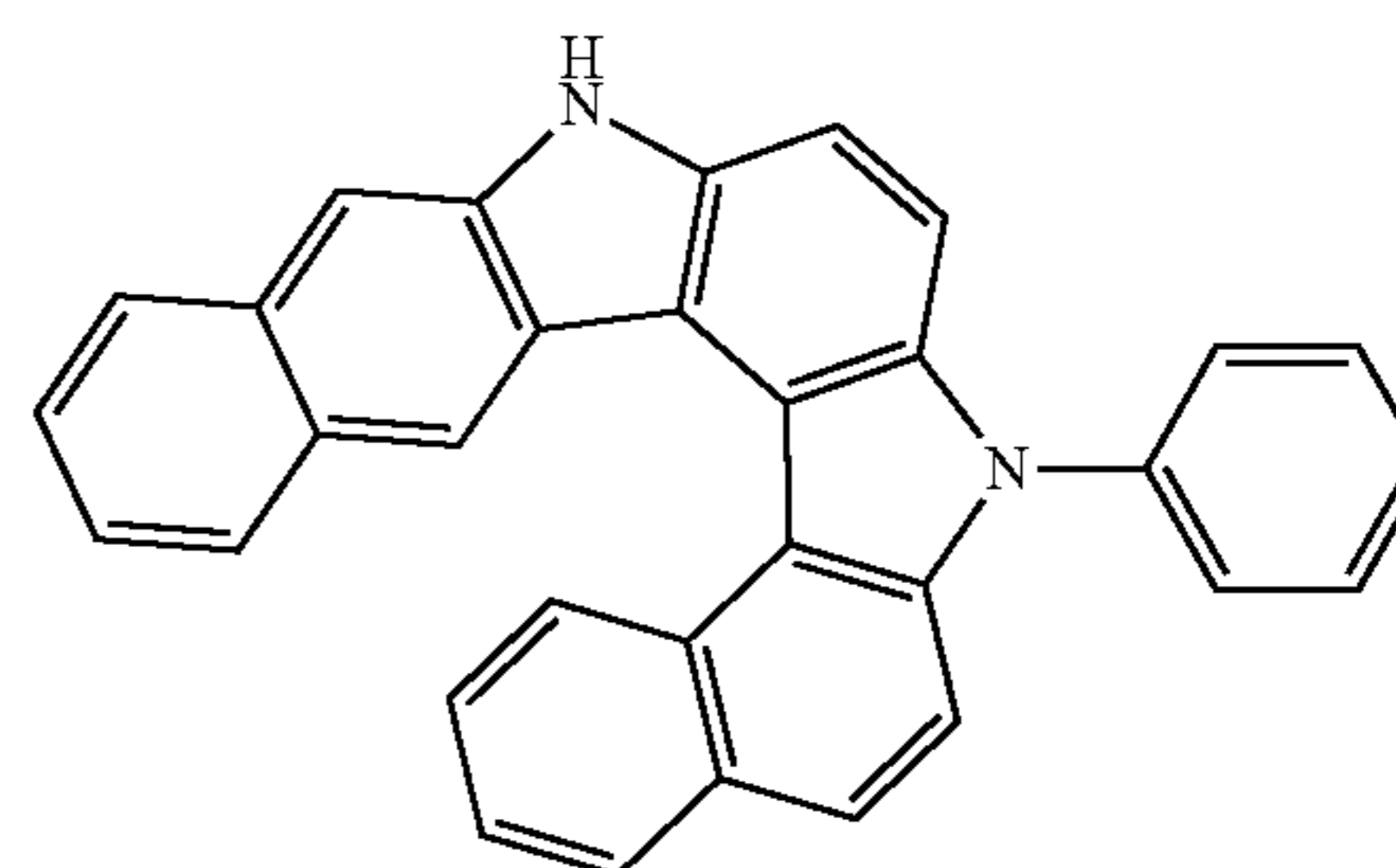
Sub 3-3-2

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-continued



Sub 3-4-6



Sub 3(39)

Synthesis Method of Sub 3-2-6

Sub 3-1-6 (57.7 g, 155 mmol) was carried out in the same manner as in Sub 3-2-1 to give the product Sub 3-2-6 (50.7 g, 78%).

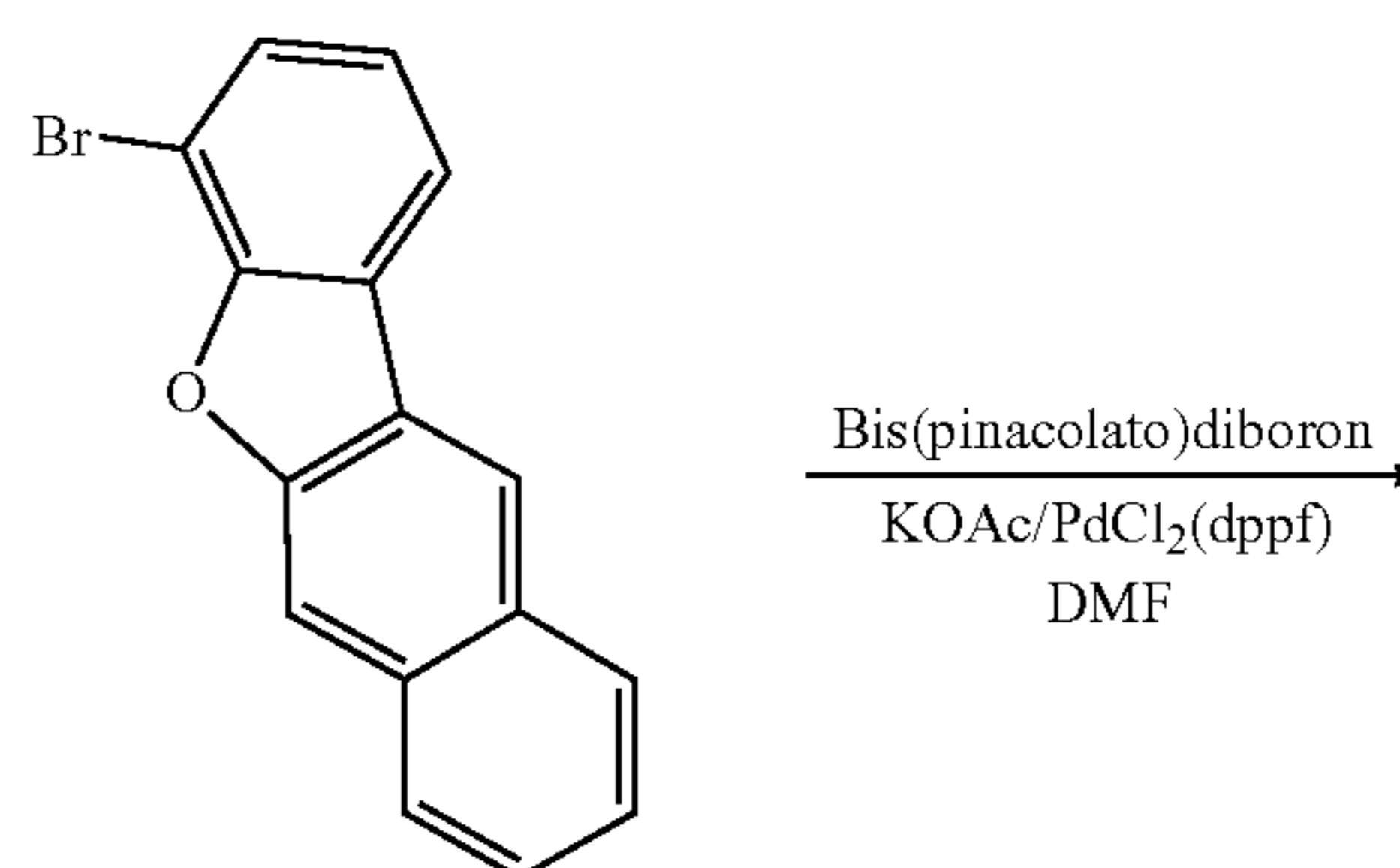
Synthesis Method of Sub 3-4-6

Sub 3-2-6 (46.5 g, 111 mmol) and Sub 3-3-2 (33.5 g, 133 mmol) were carried out in the same manner as in Sub 3-4-1 to give the product Sub 3-4-6 (47.8 g, 81%).

Synthesis Method of Sub 3(39)

Sub 3-4-6 (26.2 g, 56.3 mmol) was carried out in the same manner as in Sub 3(1) to give the product Sub 3(39) (19.2 g, 79%).

Synthesis Example of Sub 3(45)

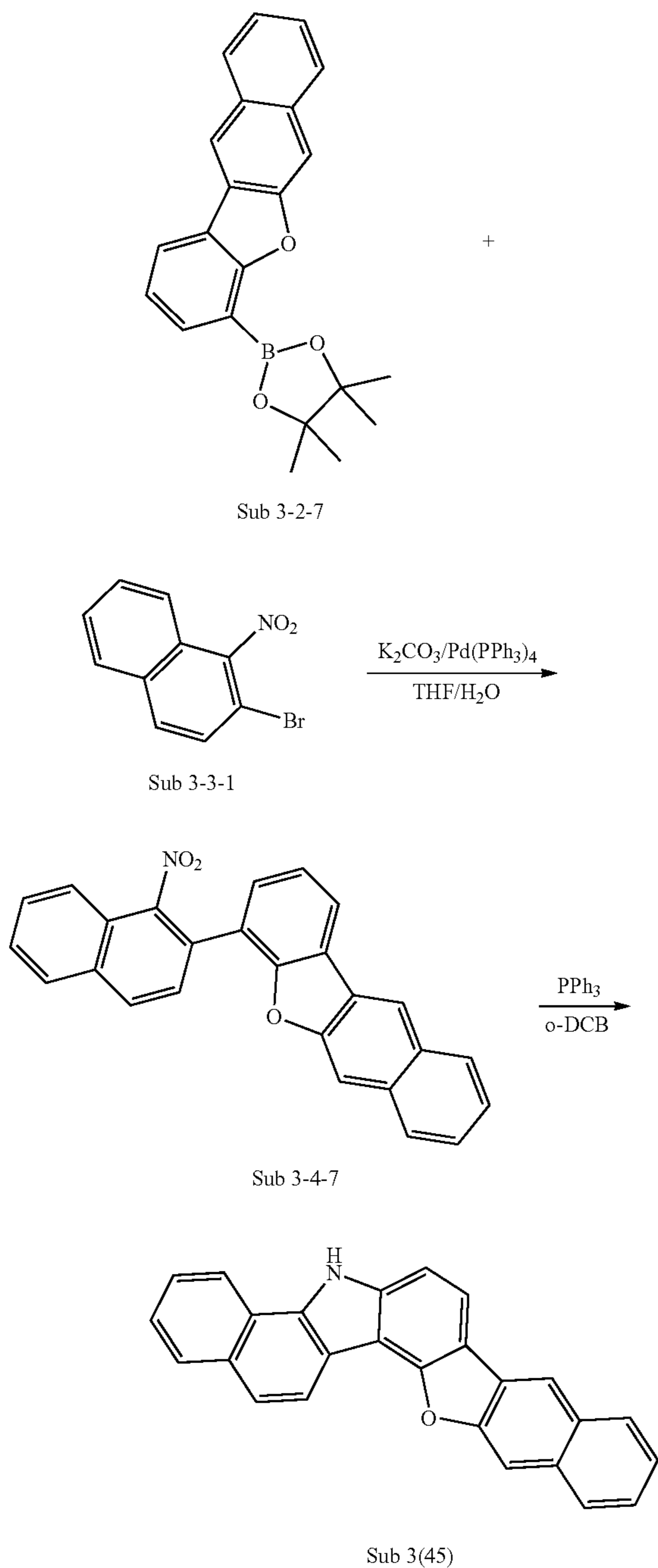


Sub 3-1-7



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-continued



## Synthesis Method of Sub 3-2-7

Sub 3-1-7 (46.1 g, 155 mmol) was carried out in the same manner as in Sub 3-2-1 to give the product Sub 3-2-7 (43.8 g, 82%).

## Synthesis Method of Sub 3-4-7

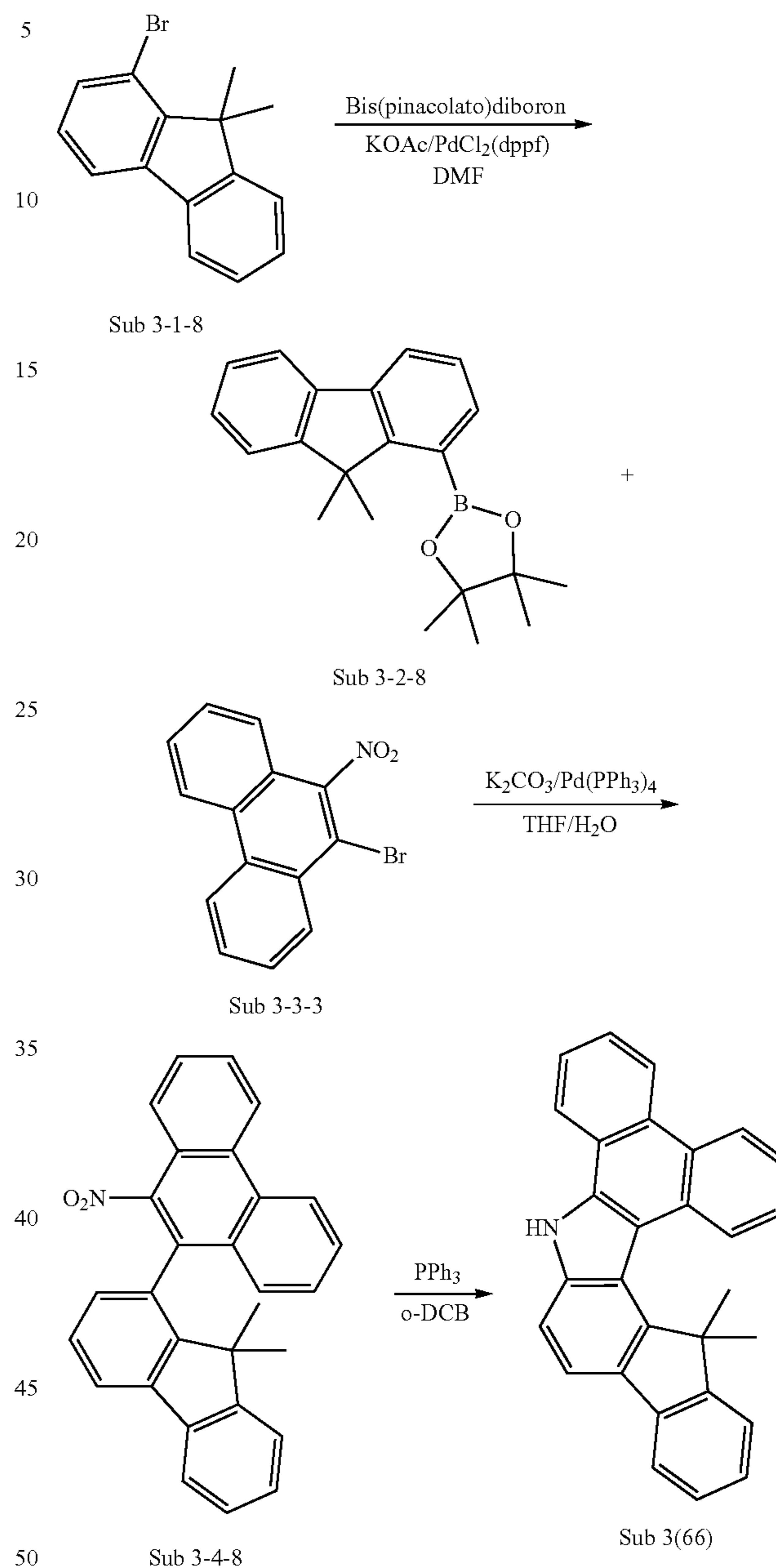
Sub 3-2-7 (38.2 g, 111 mmol) and Sub 3-3-1 (33.5 g, 133 mmol) were carried out in the same manner as in Sub 3-4-1 to give the product Sub 3-4-7 (35.9 g, 83%).

## Synthesis Method of Sub 3(45)

Sub 3-4-7 (21.9 g, 56.3 mmol) was carried out in the same manner as in Sub 3(1) to give the product Sub 3(45) (16.1 g, 80%).

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Synthesis Example of Sub 3(66)



## Synthesis Method of Sub 3-2-8

Sub 3-1-8 (42.3 g, 155 mmol) was carried out in the same manner as in Sub 3-2-1 to give the product Sub 3-2-8 (40.2 g, 81%).

## Synthesis Method of Sub 3-4-8

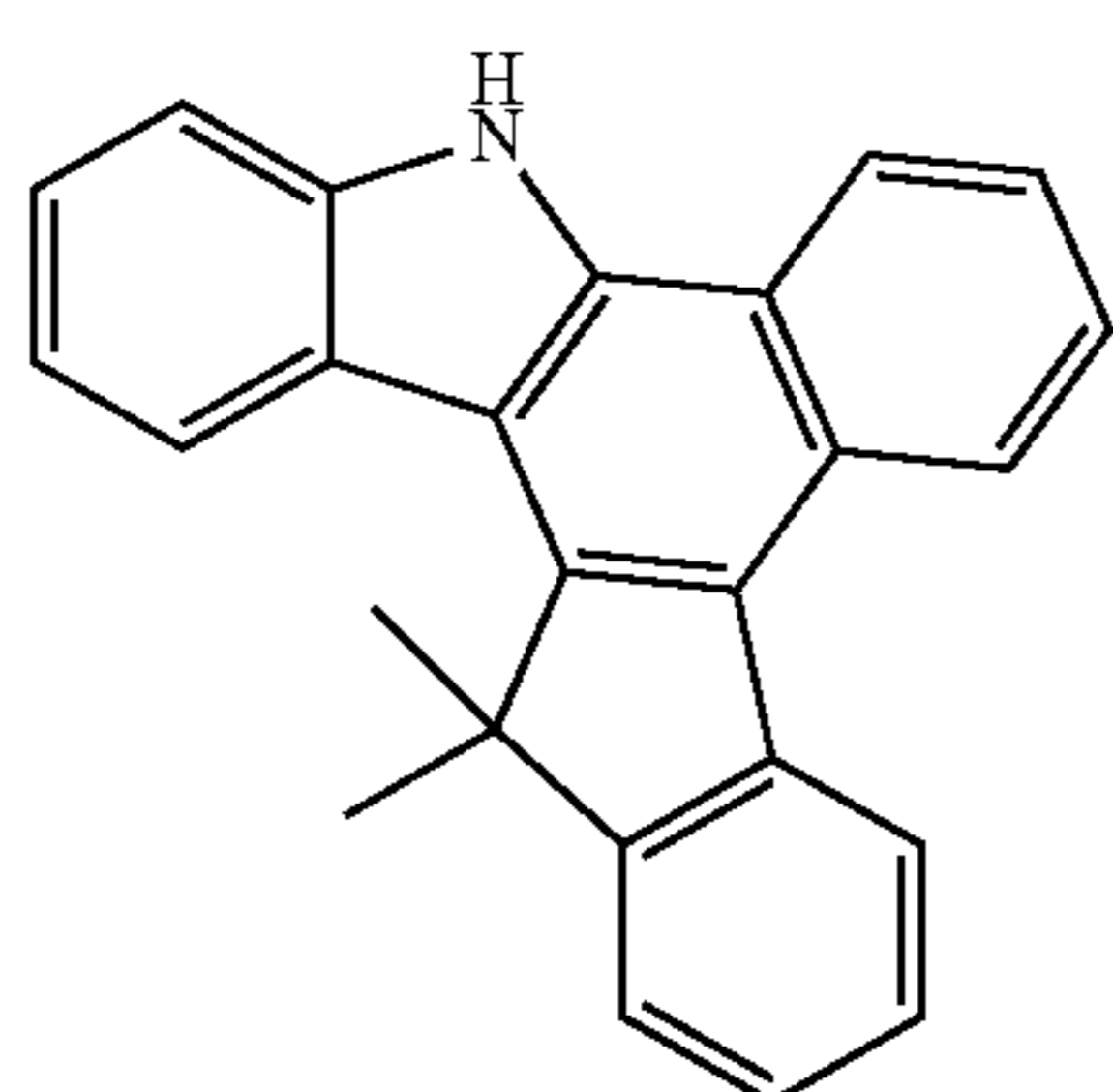
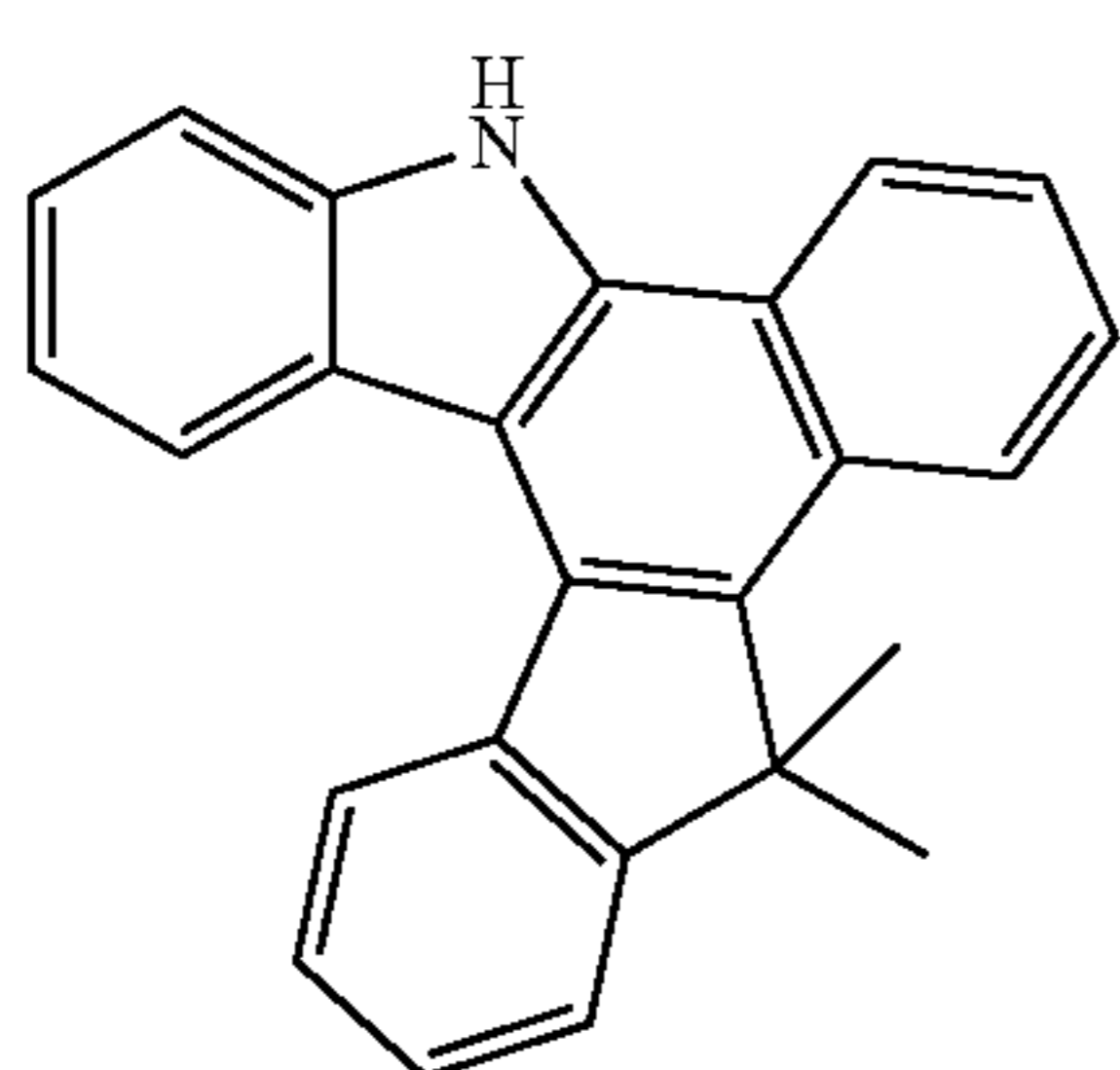
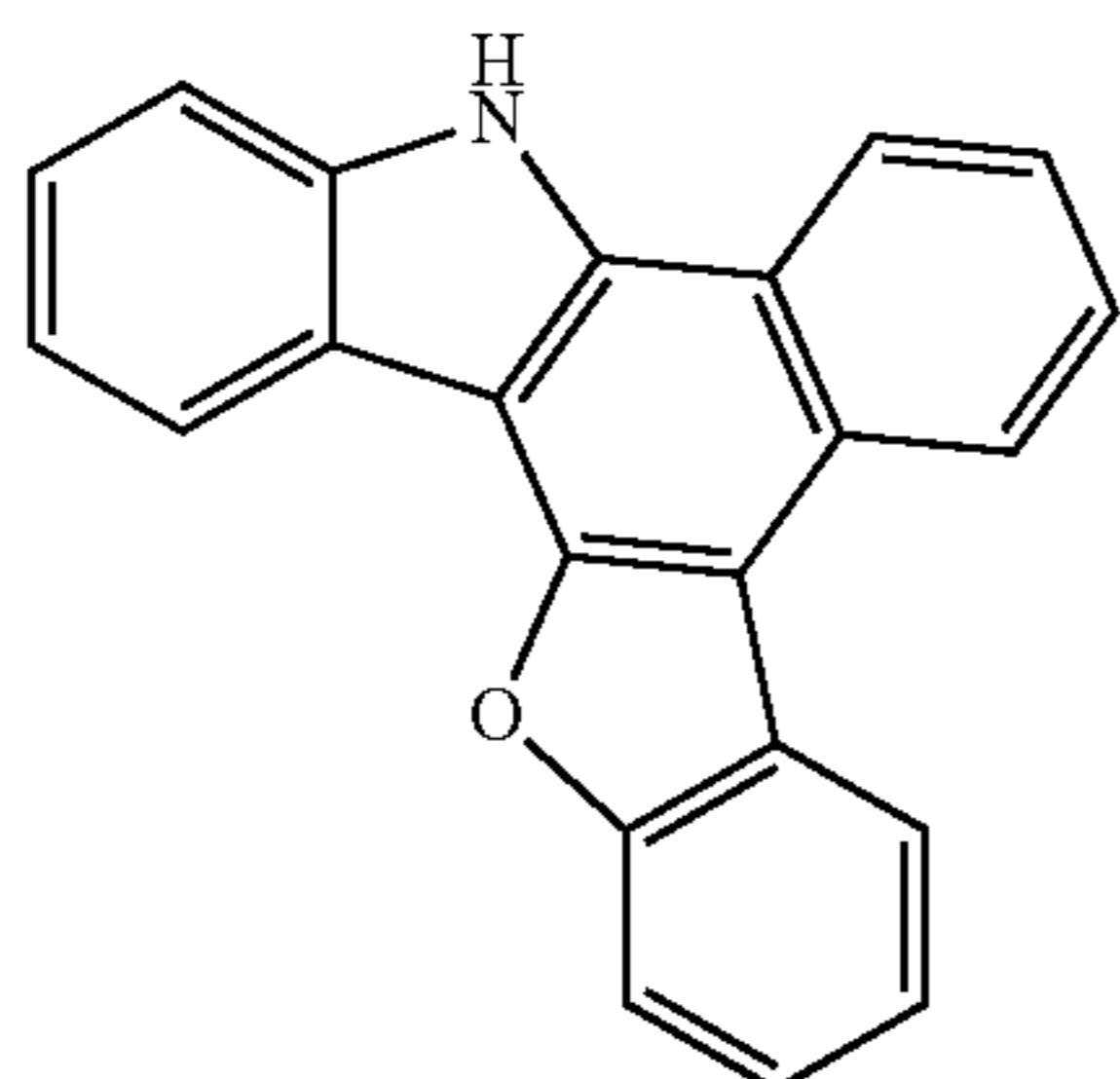
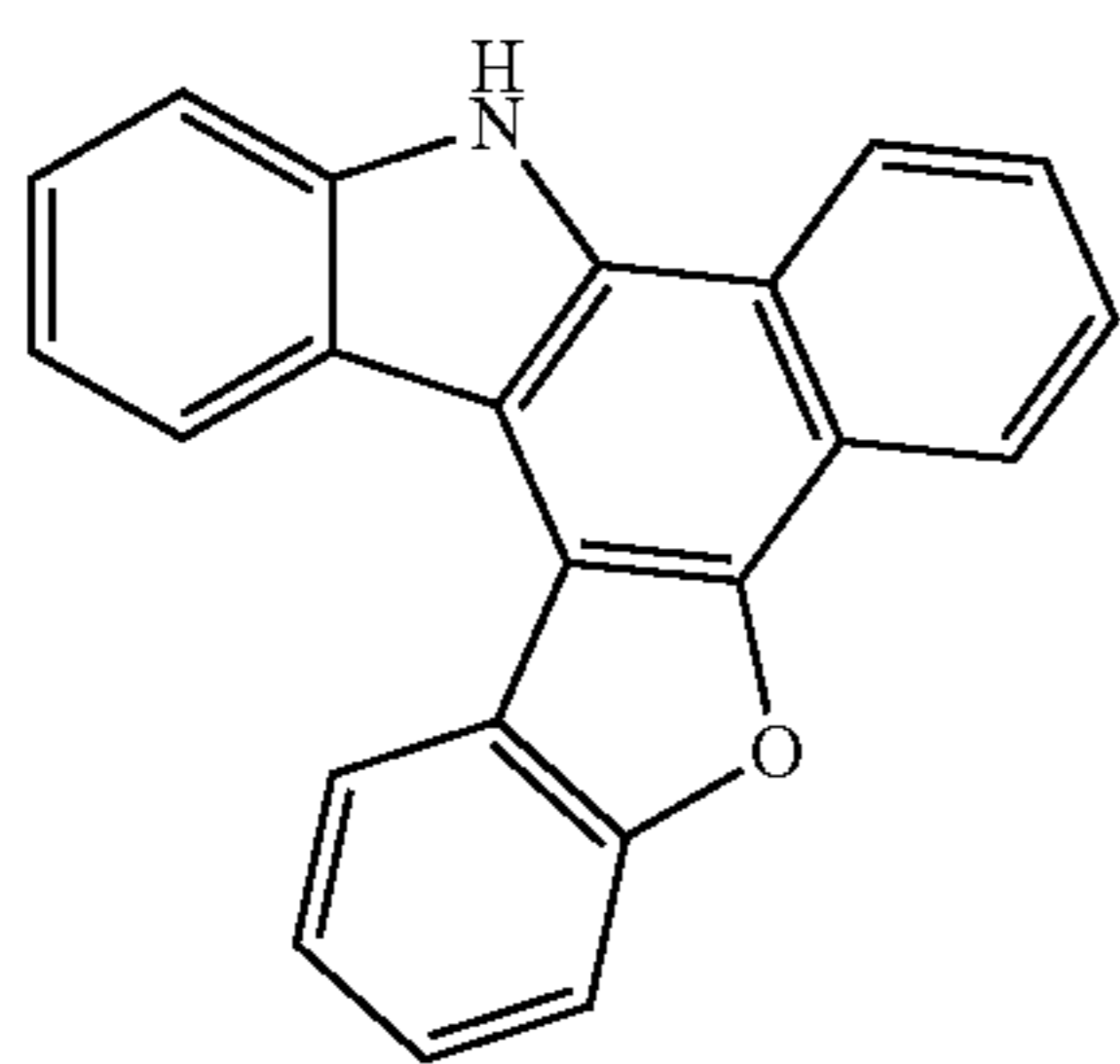
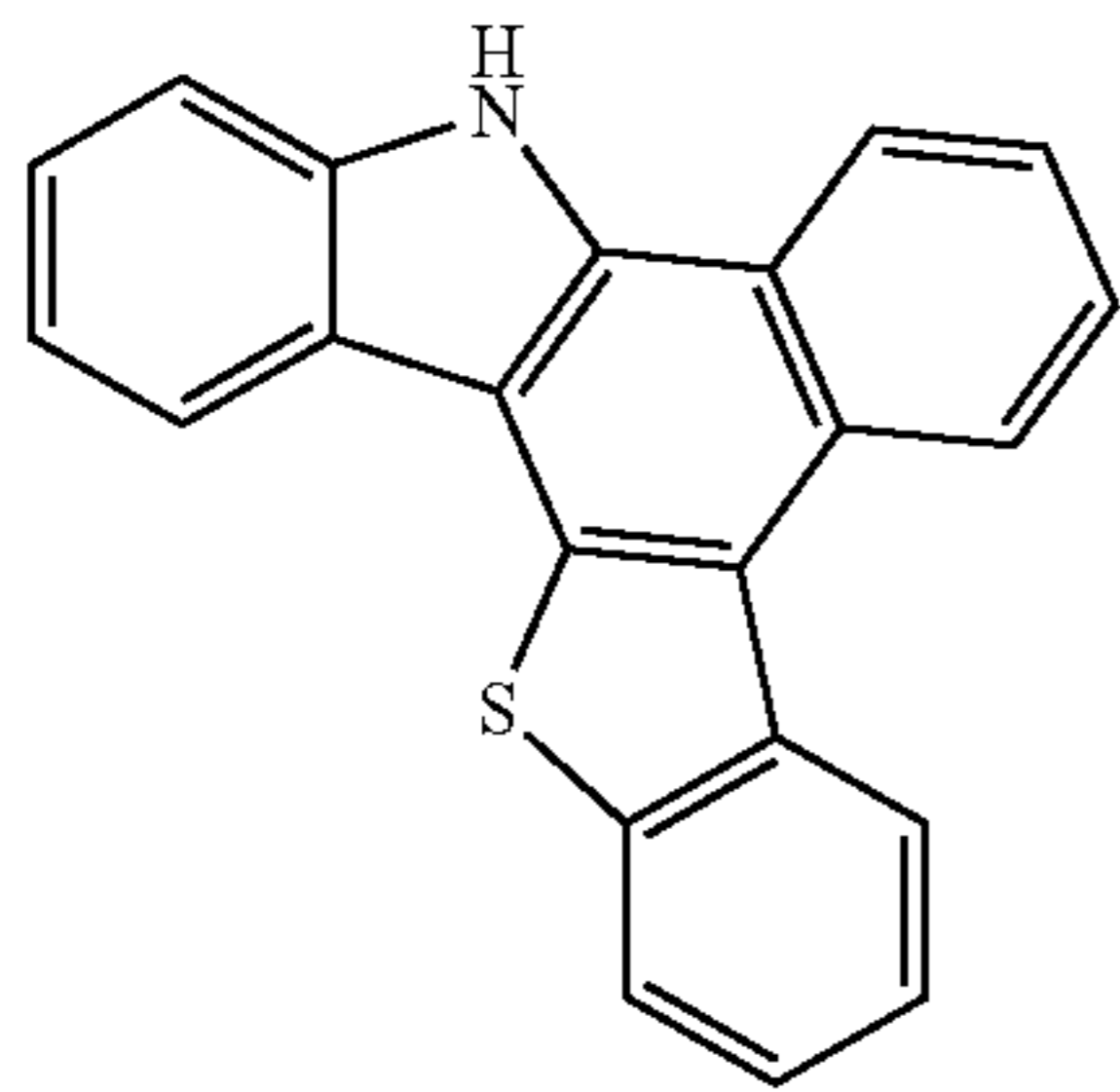
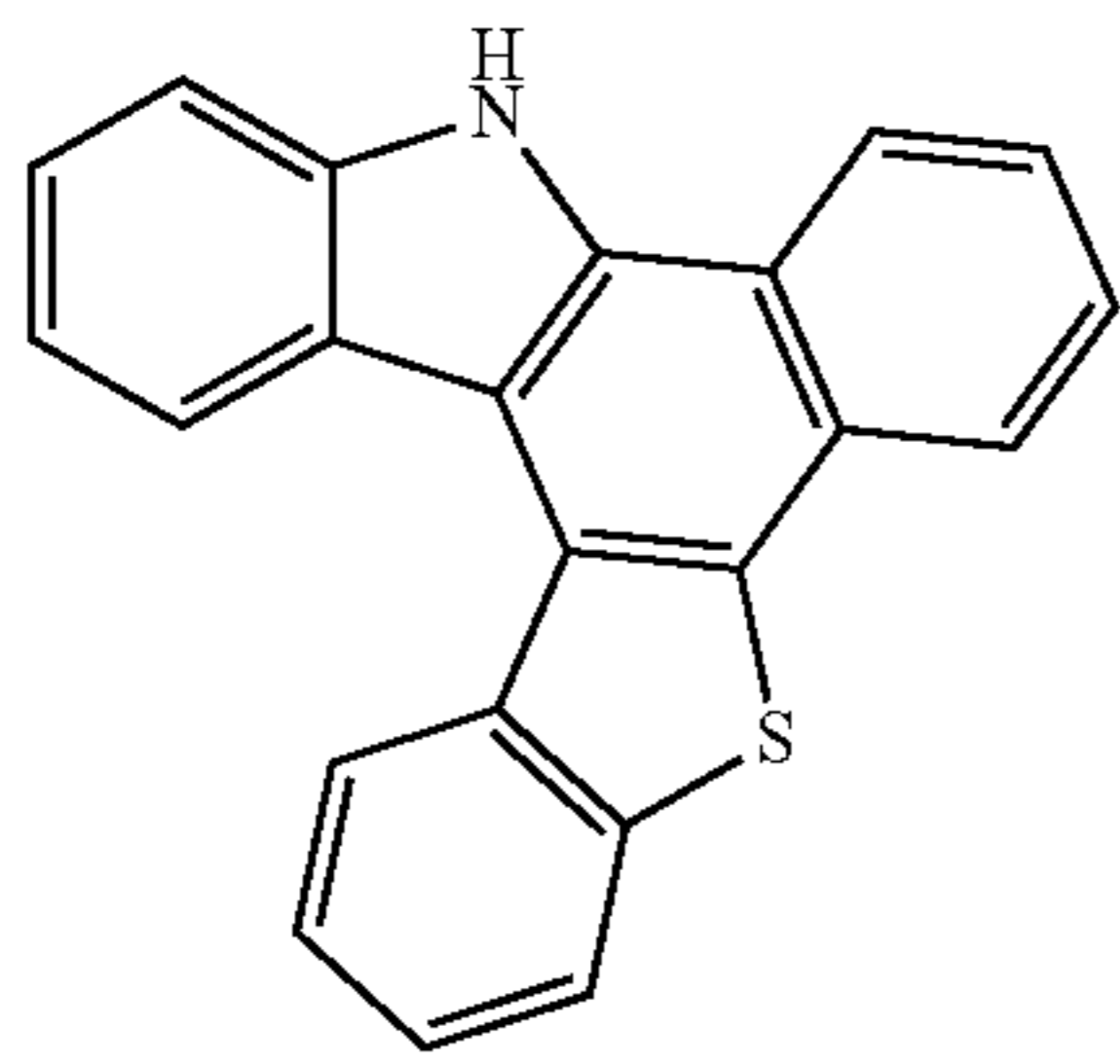
Sub 3-2-8 (35.5 g, 111 mmol) and Sub 3-3-3 (40.2 g, 133 mmol) were carried out in the same manner as in Sub 3-4-1 to give the product Sub 3-4-8 (37.8 g, 82%).

## Synthesis Method of Sub 3(66)

Sub 3-4-8 (23.4 g, 56.3 mmol) was carried out in the same manner as in Sub 3(1) to give the product Sub 3(66) (17.5 g, 80%).

Examples of Sub 3 include, but are not limited to, the followings.

125

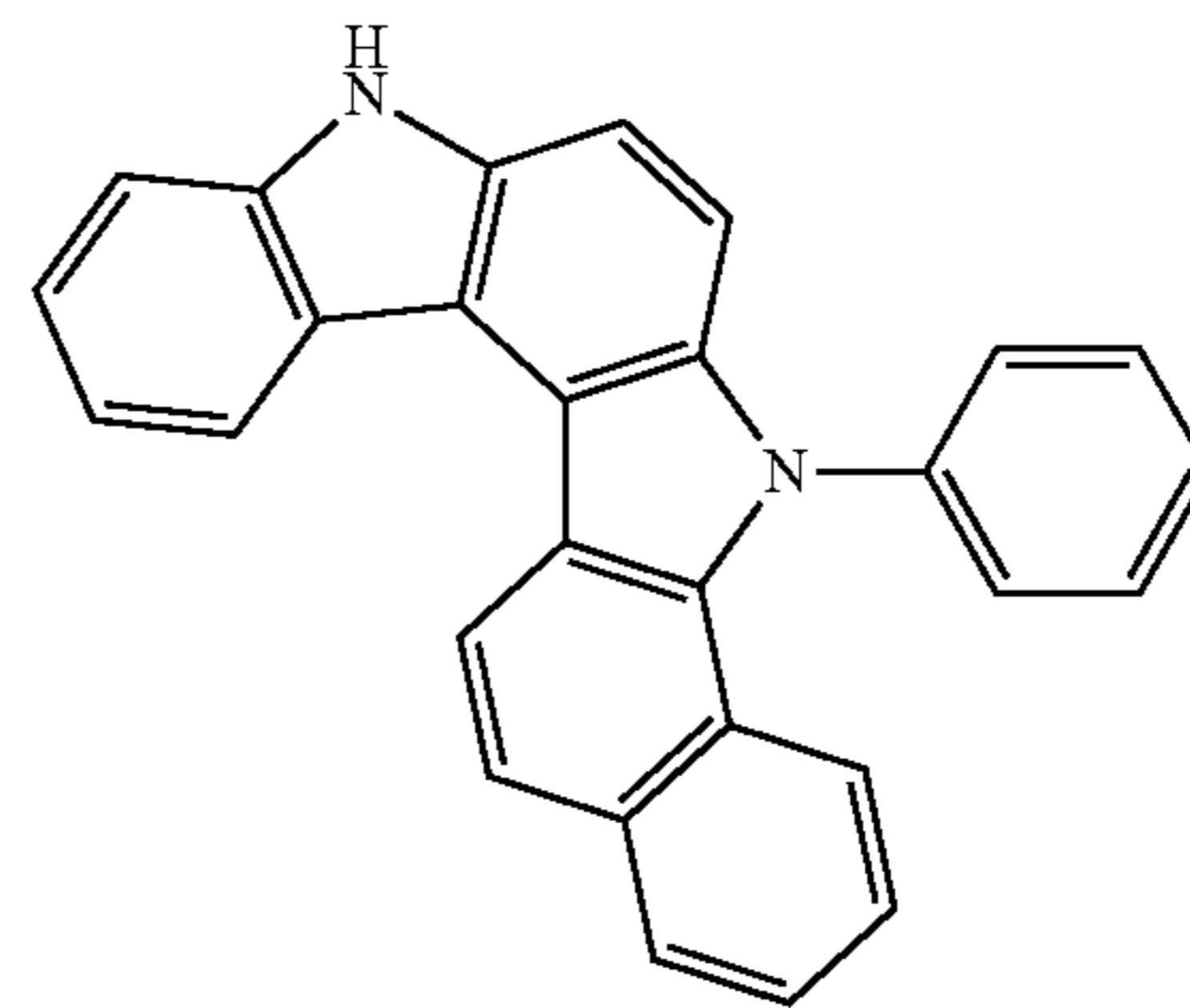


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-continued

Sub 3(1)

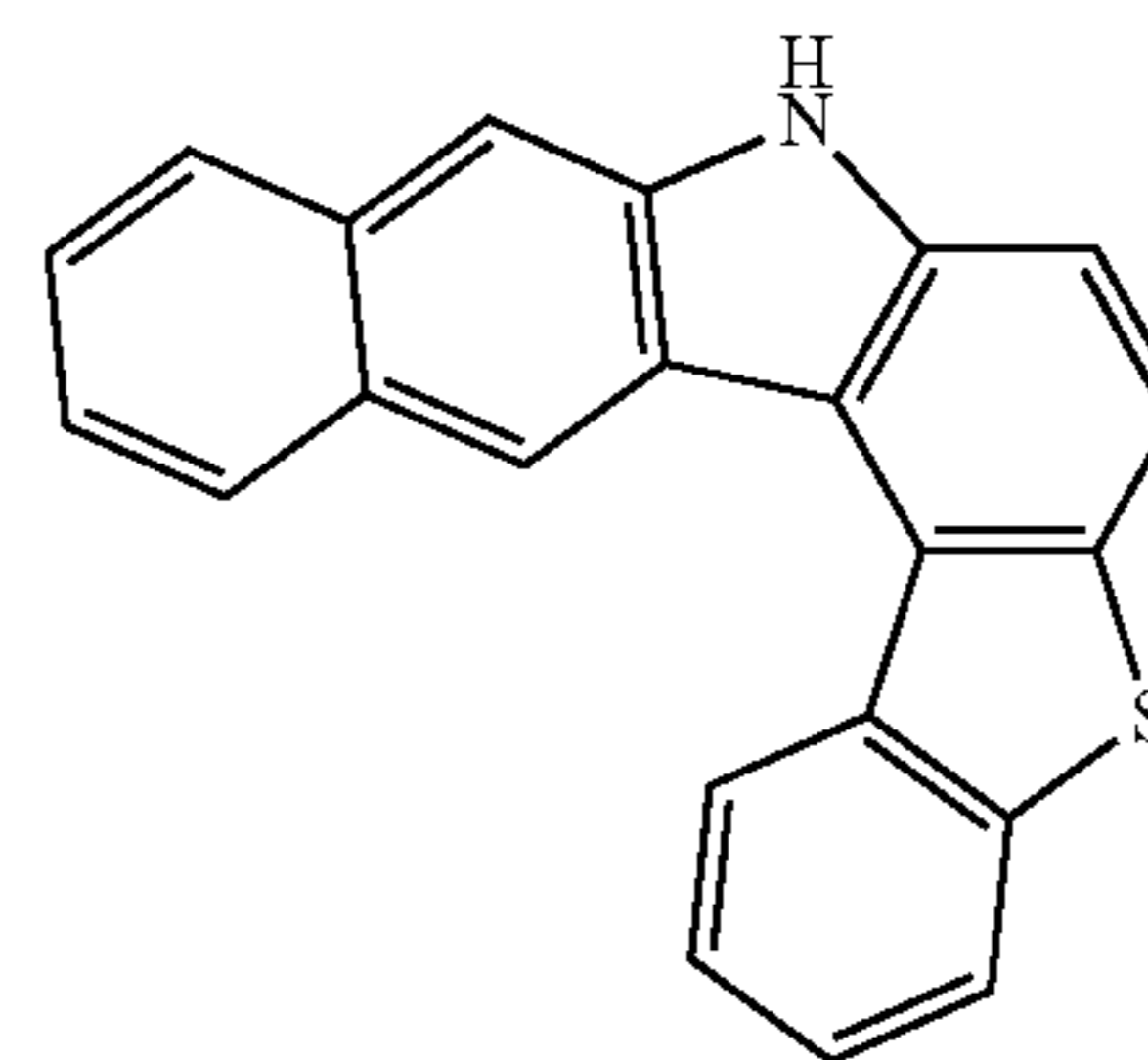
5



Sub 3(7)

Sub 3(2)

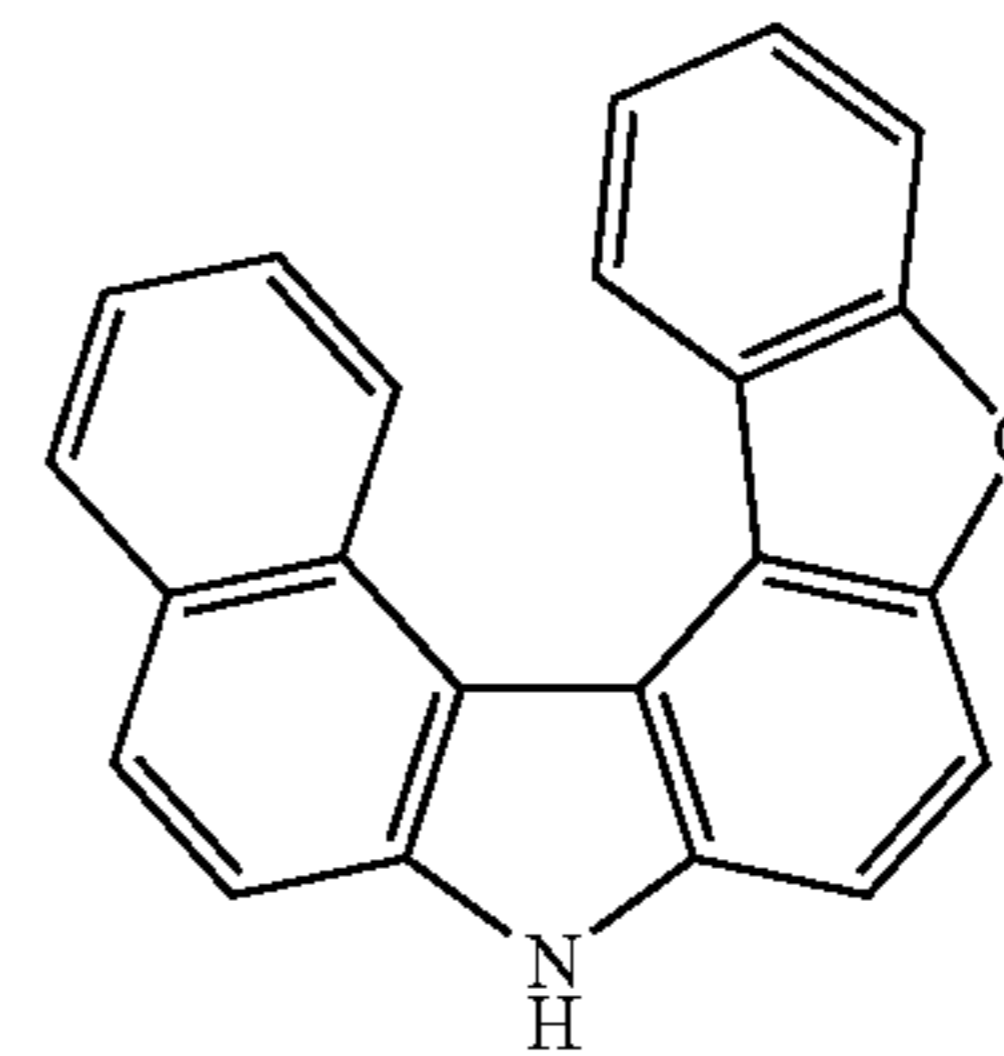
10



Sub 3(8)

Sub 3(3)

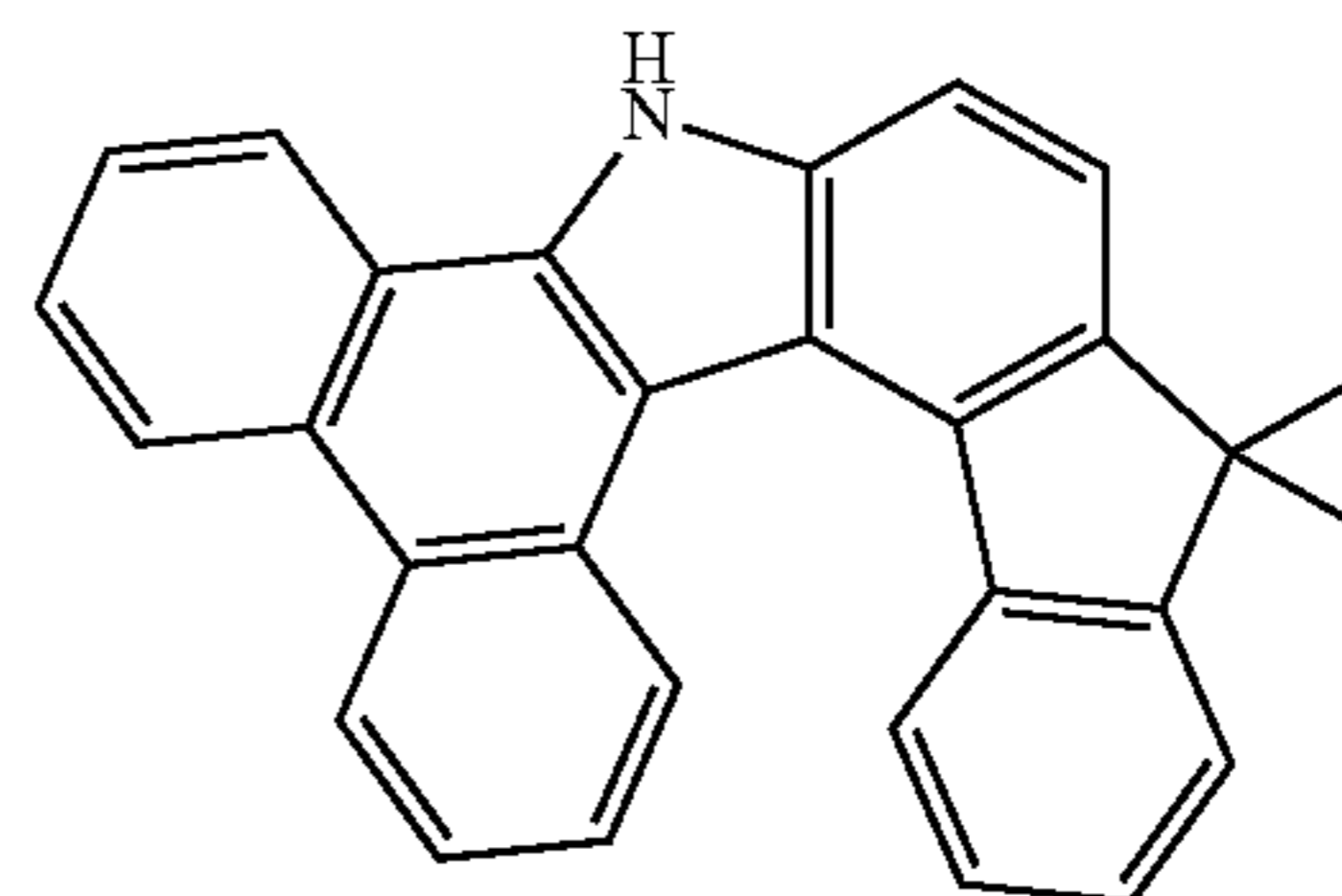
25



Sub 3(9)

Sub 3(4)

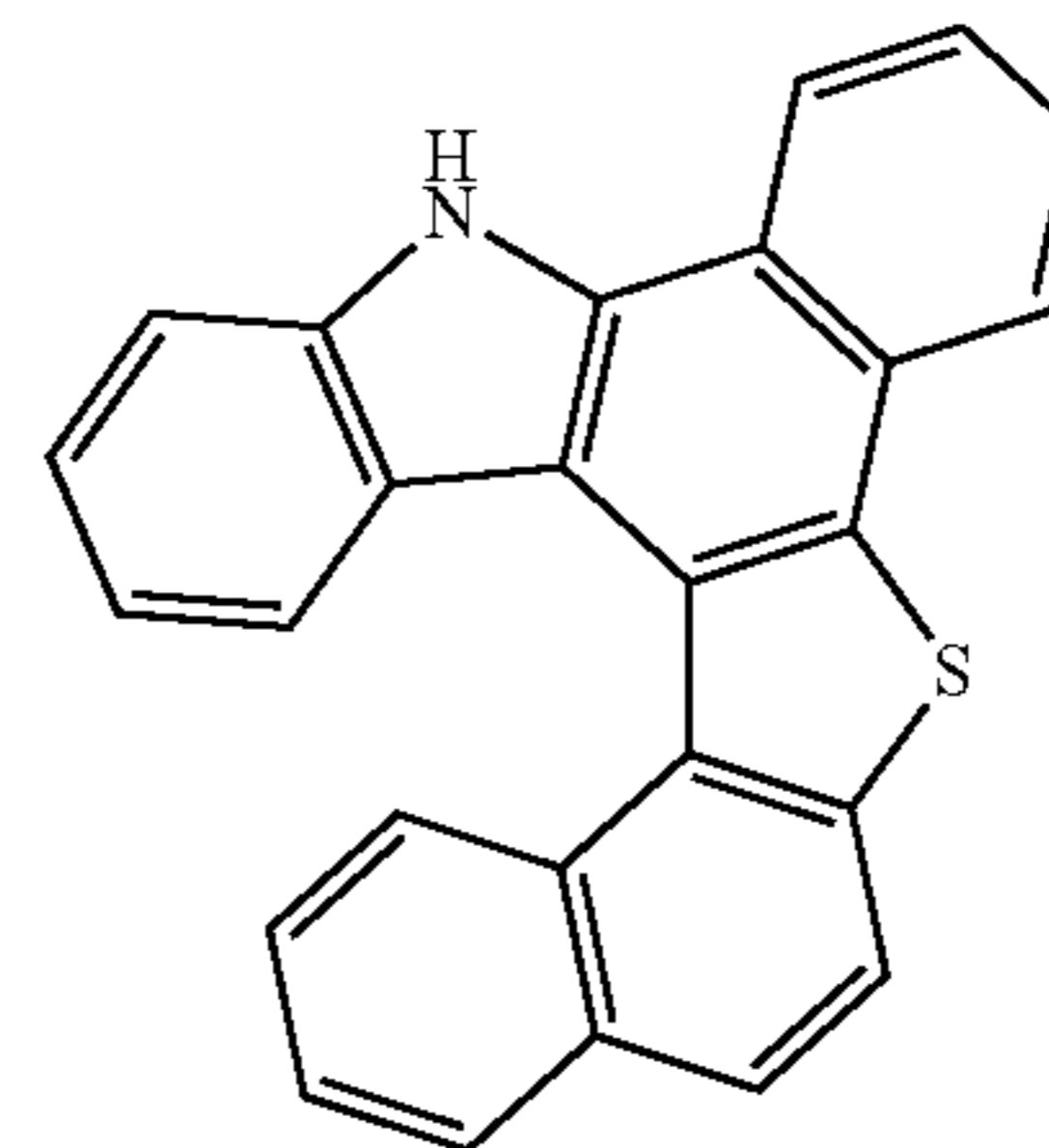
35



Sub 3(10)

Sub 3(5)

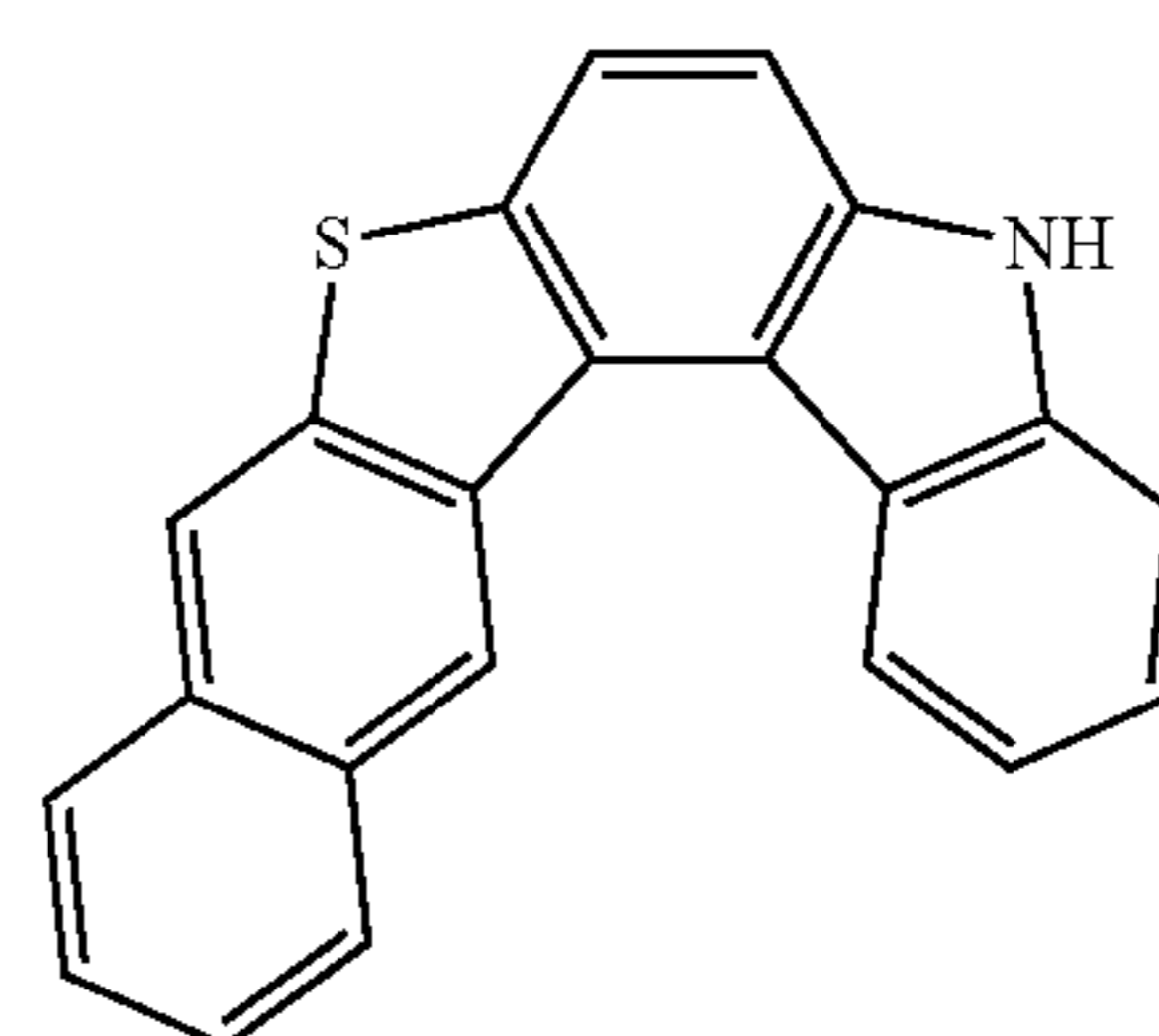
45



Sub 3(11)

Sub 3(6)

55



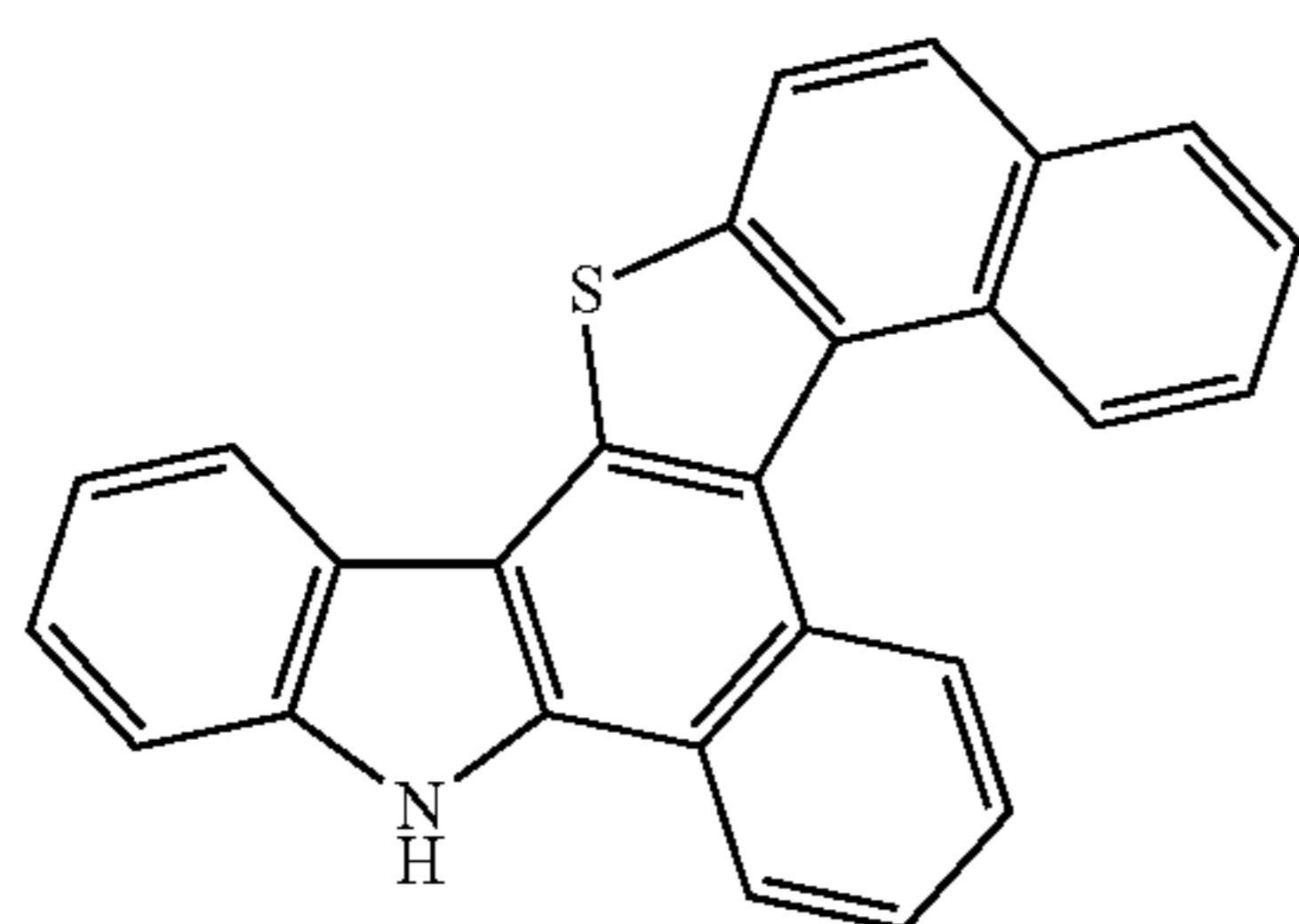
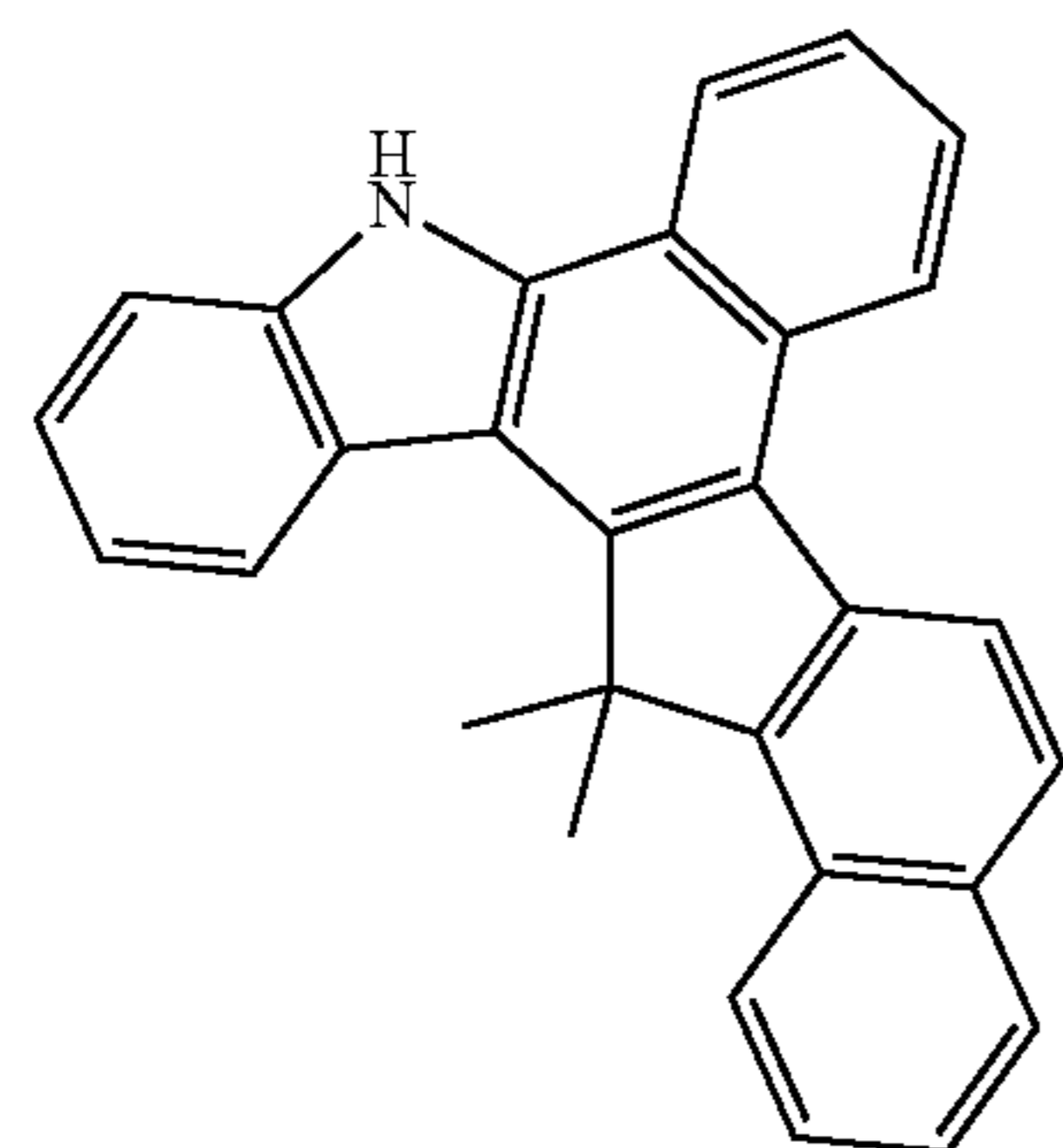
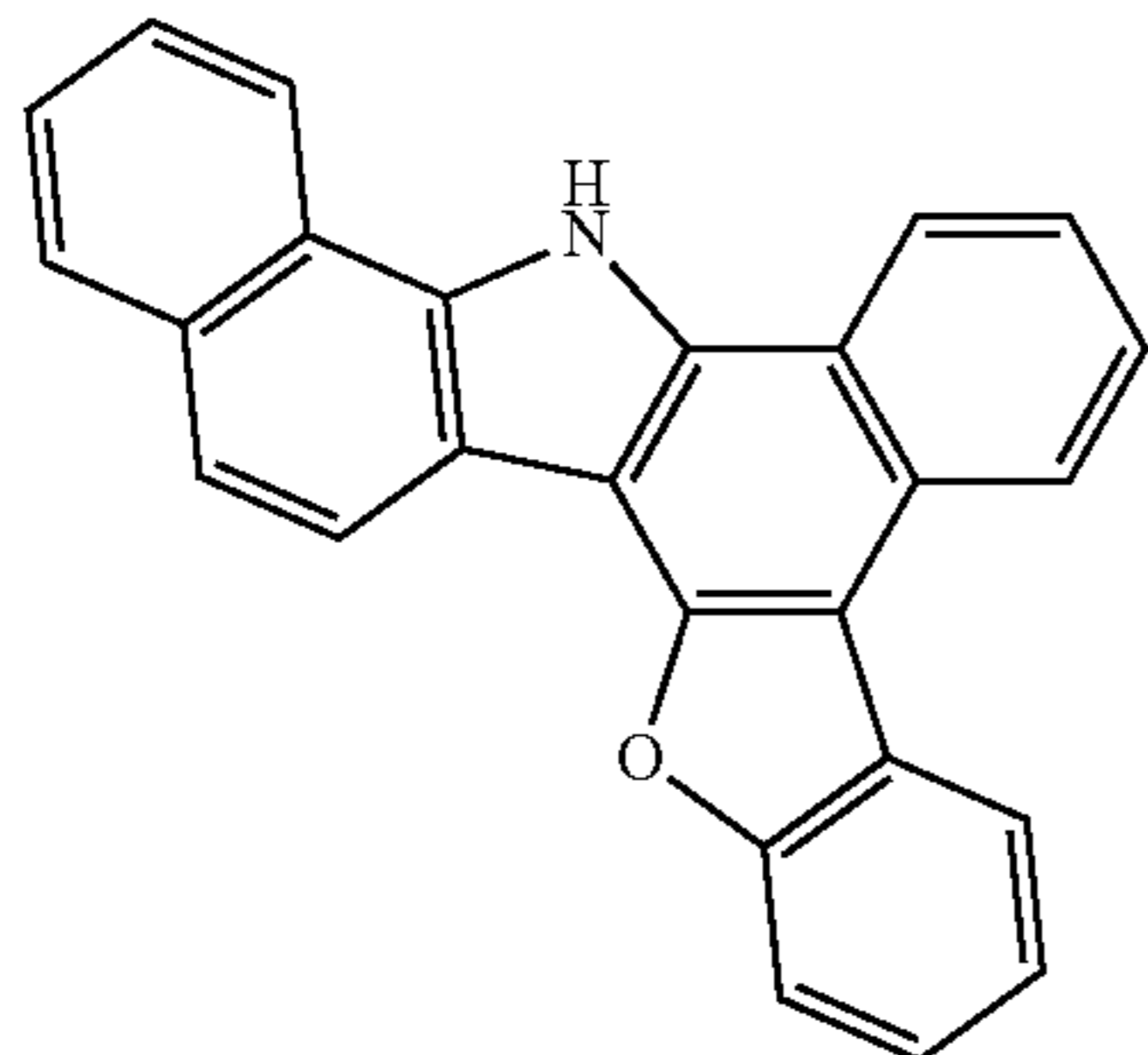
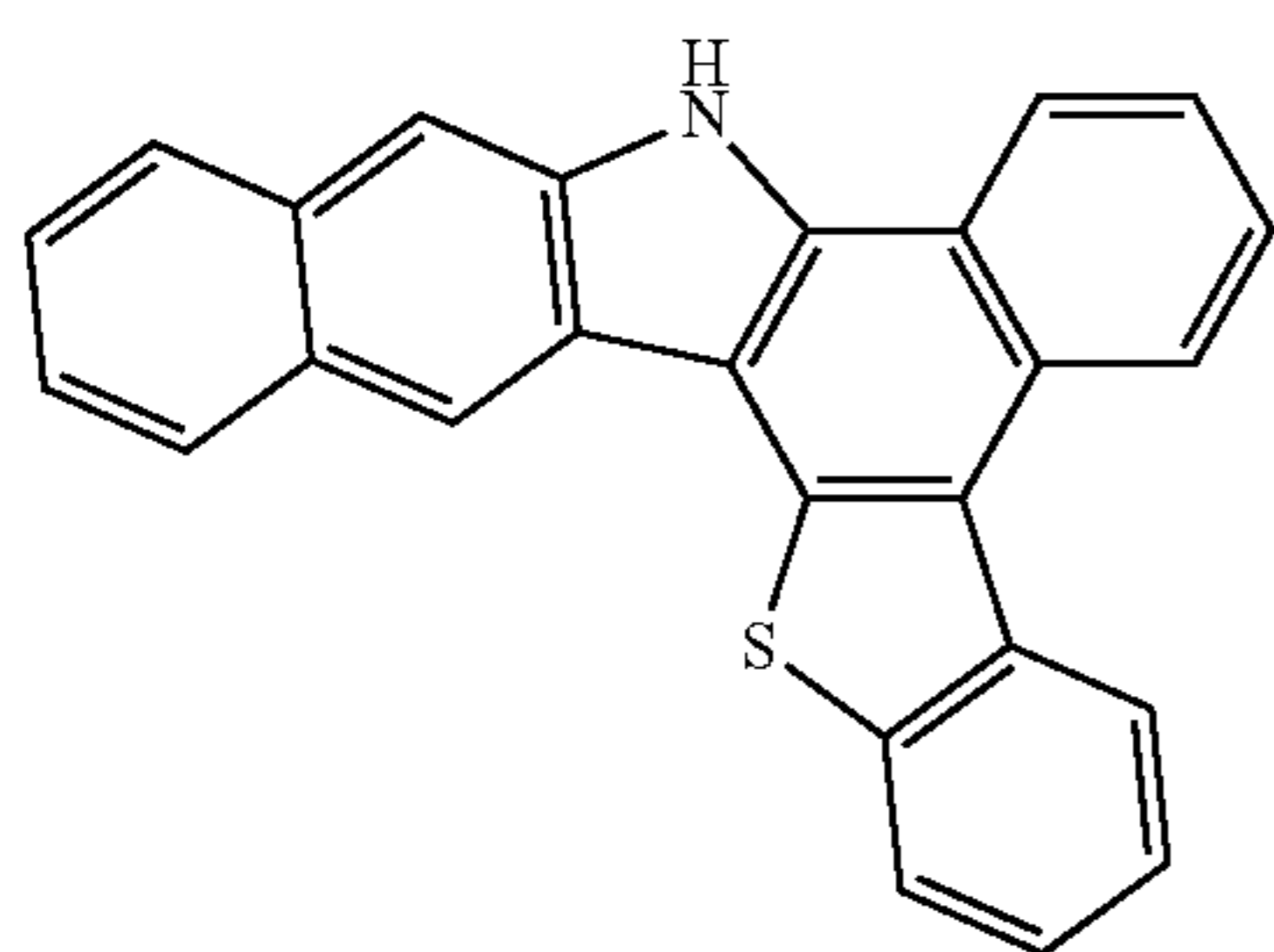
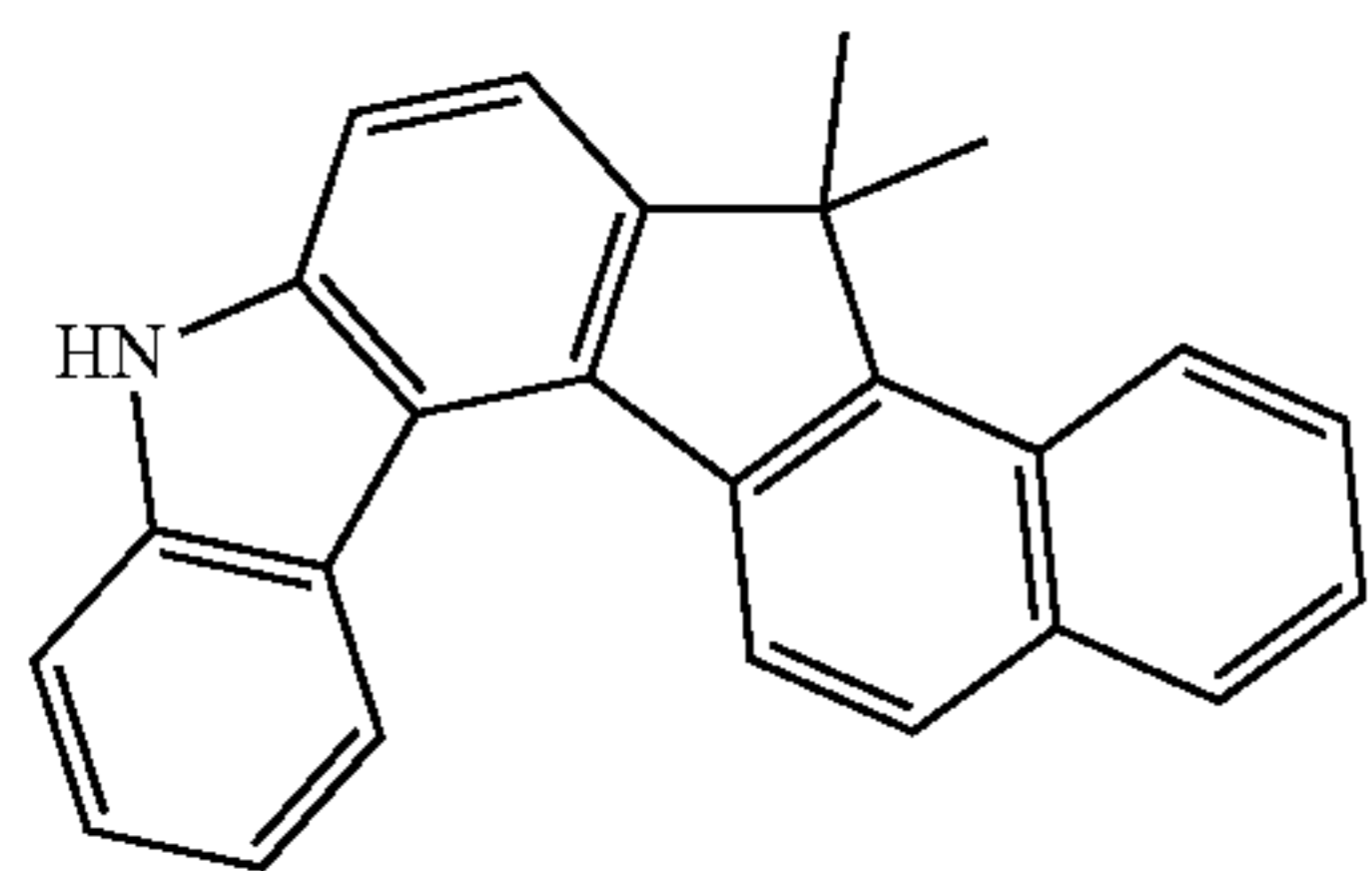
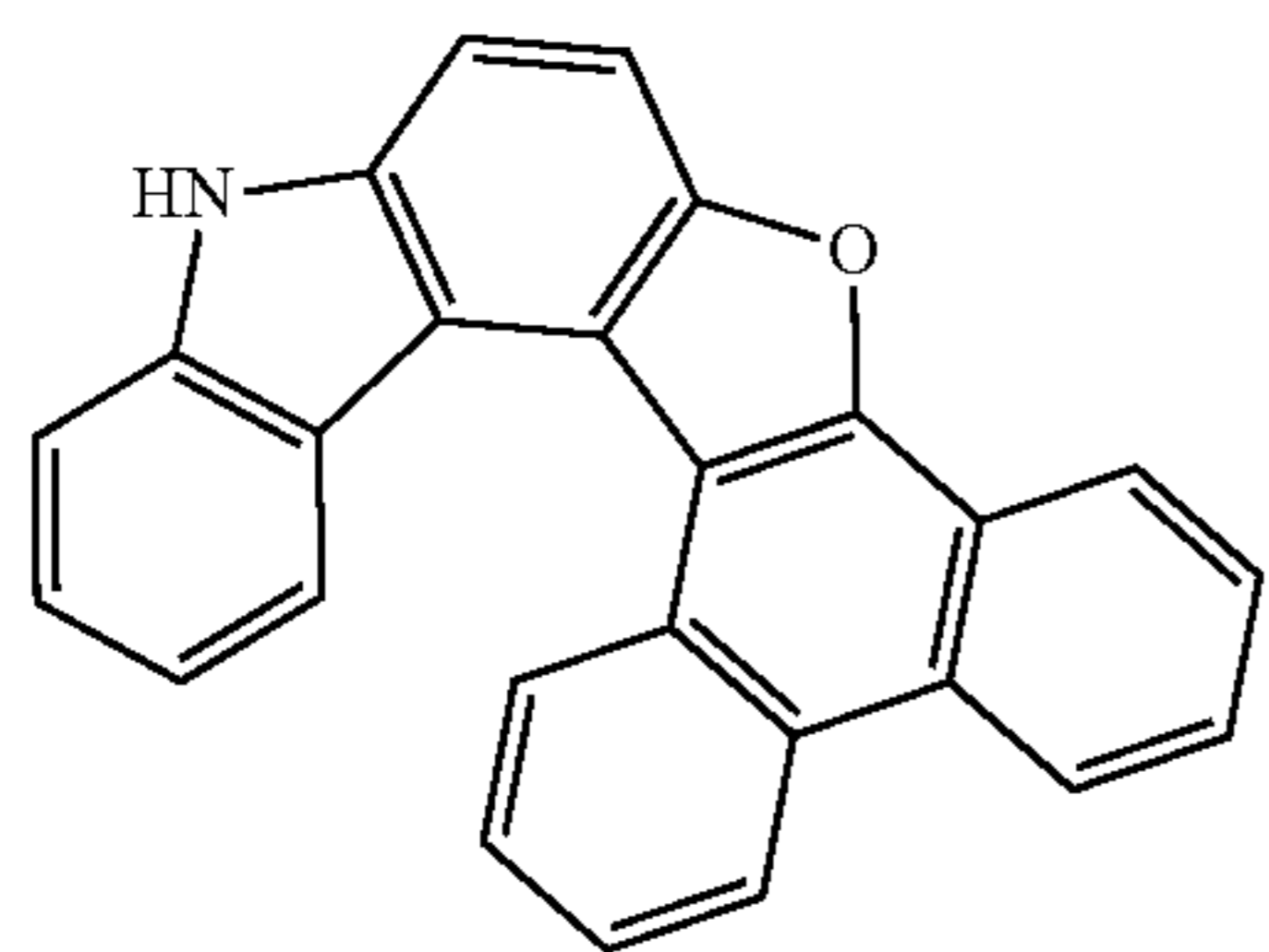
Sub 3(12)

60

65

**127**

-continued



**128**

-continued

Sub 3(13)

5

10

Sub 3(14)

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Sub 3(15)

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Sub 3(15)

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Sub 3(16)

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Sub 3(17)

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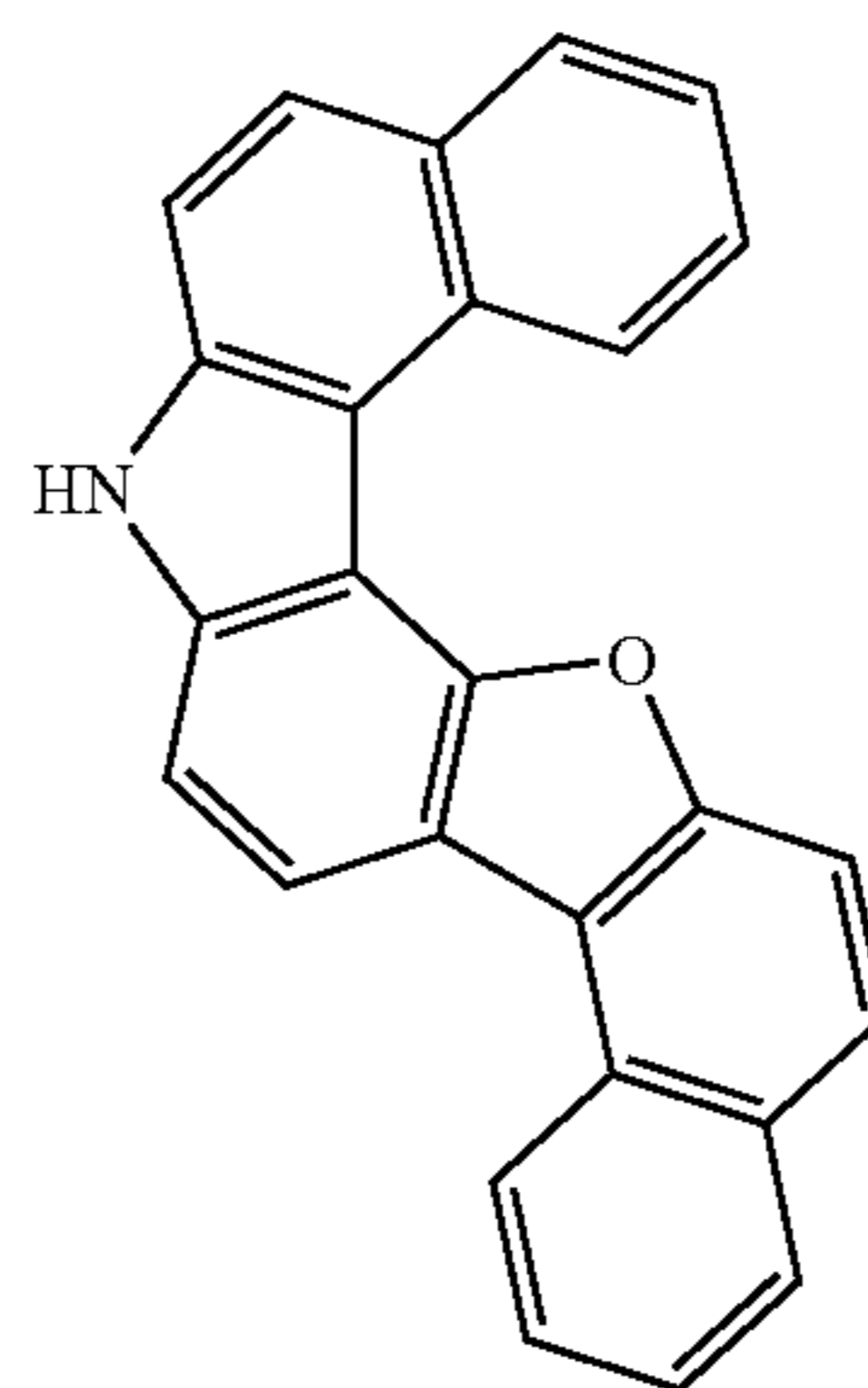
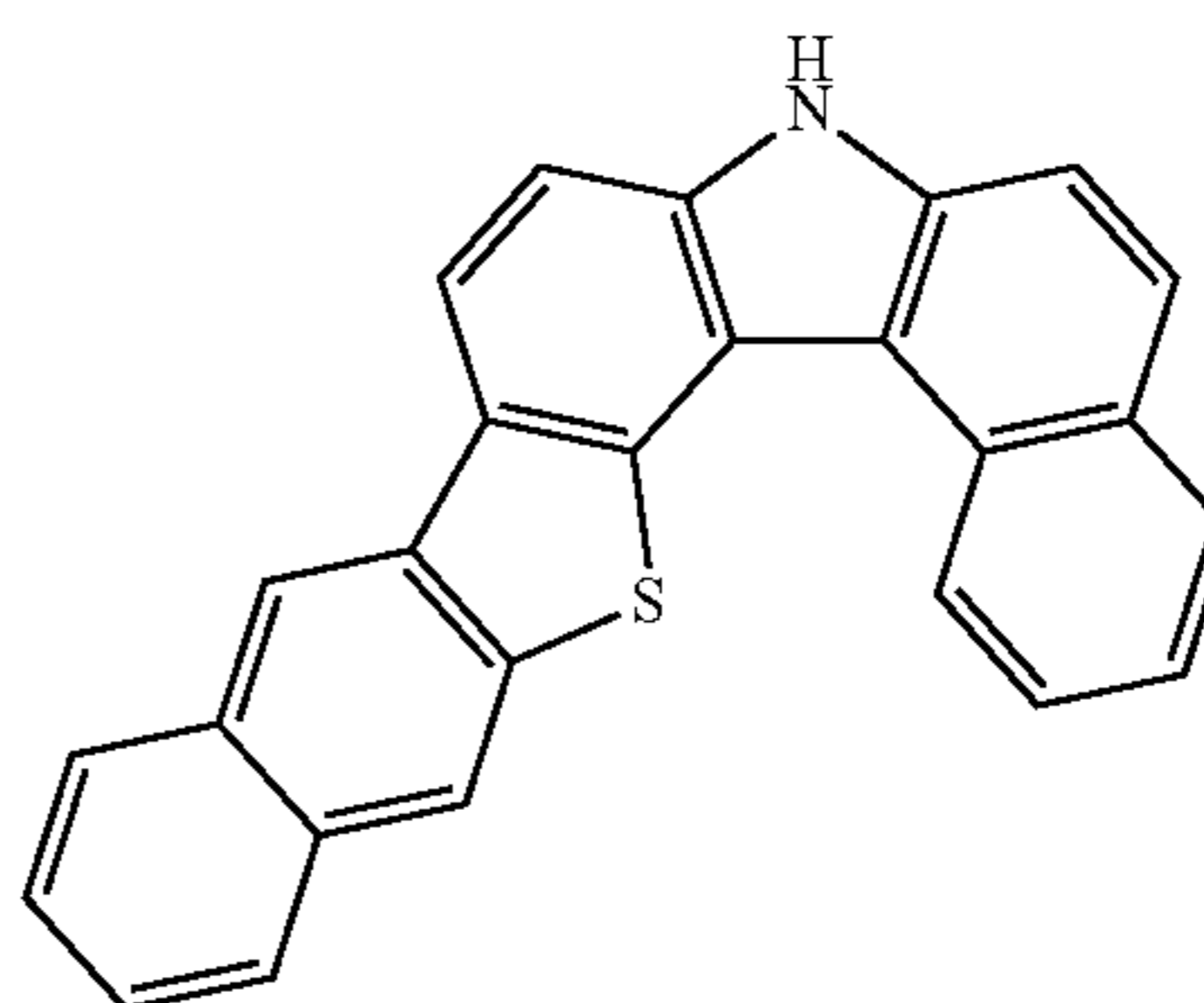
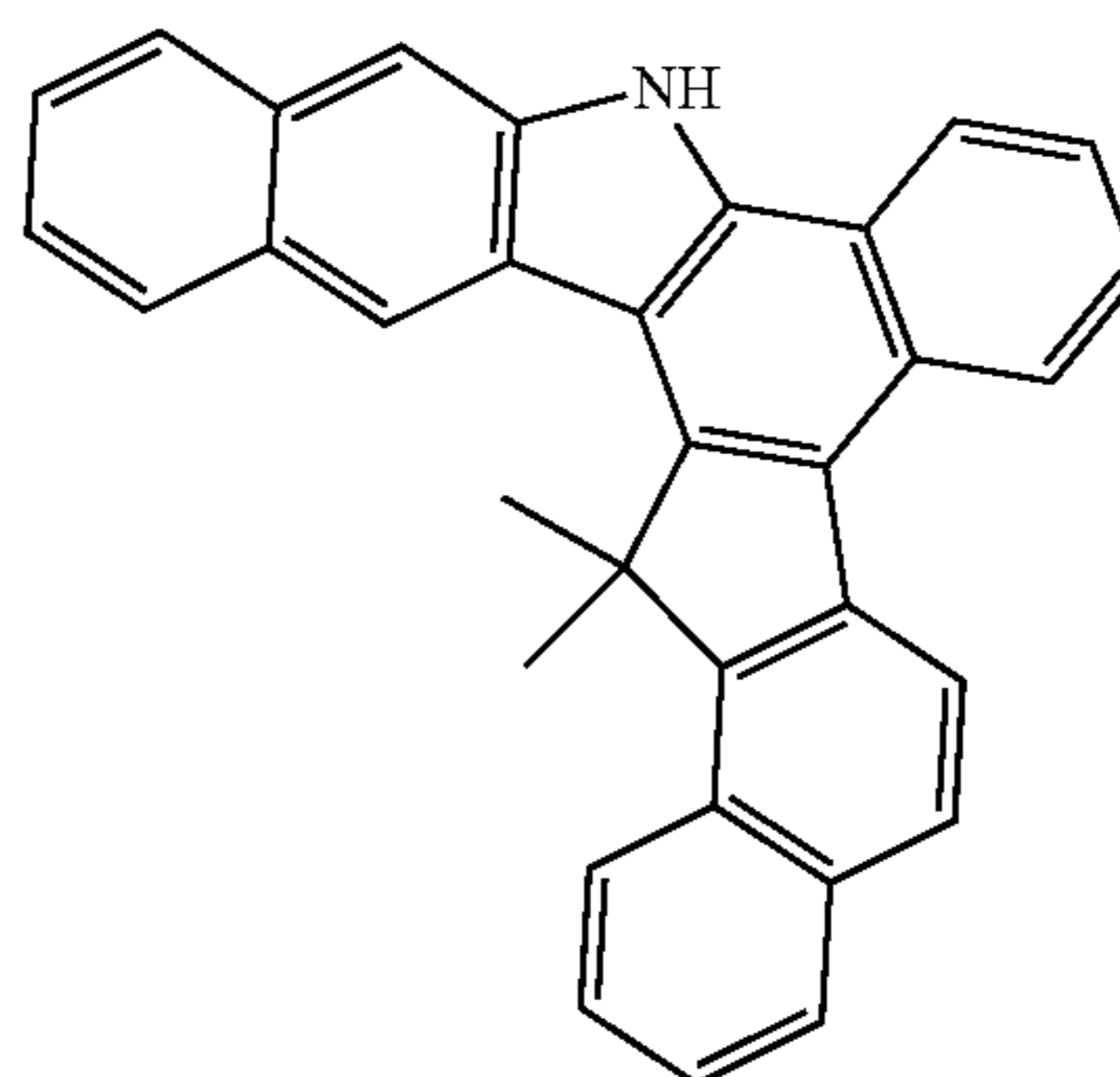
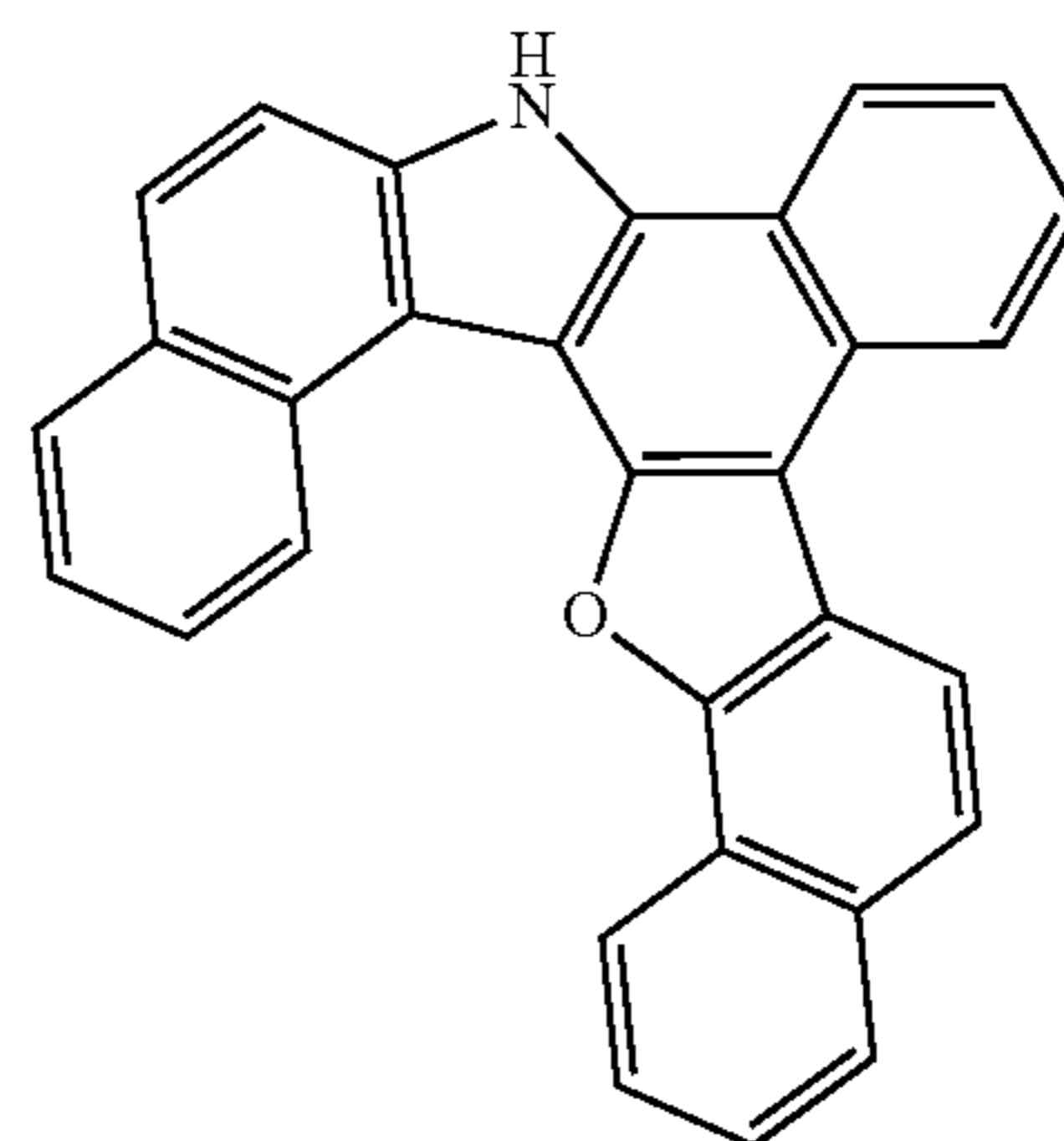
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Sub 3(18)

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Sub 3(19)

Sub 3(20)

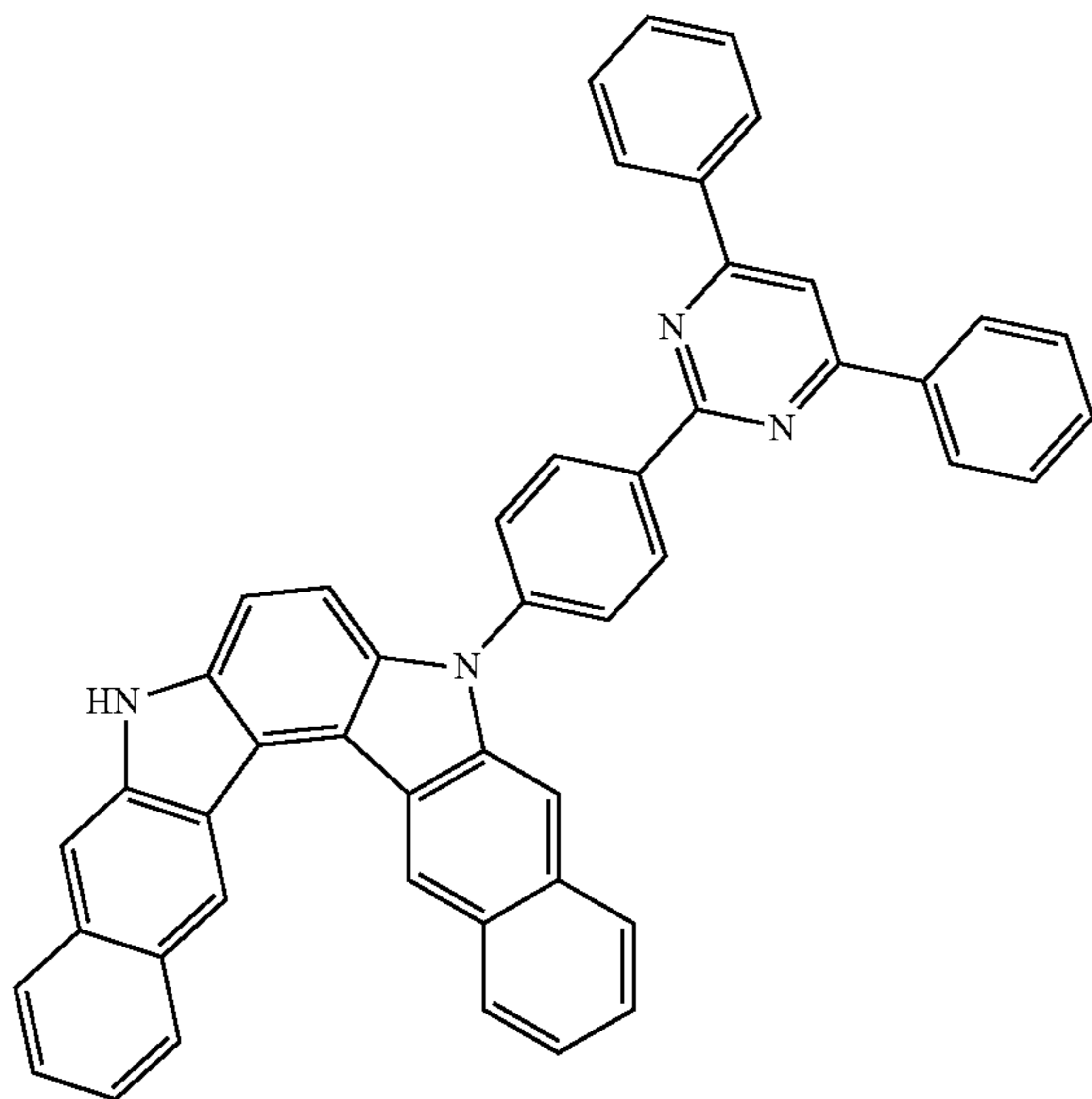
Sub 3(21)

Sub 3(22)

129

-continued

Sub 3(23)



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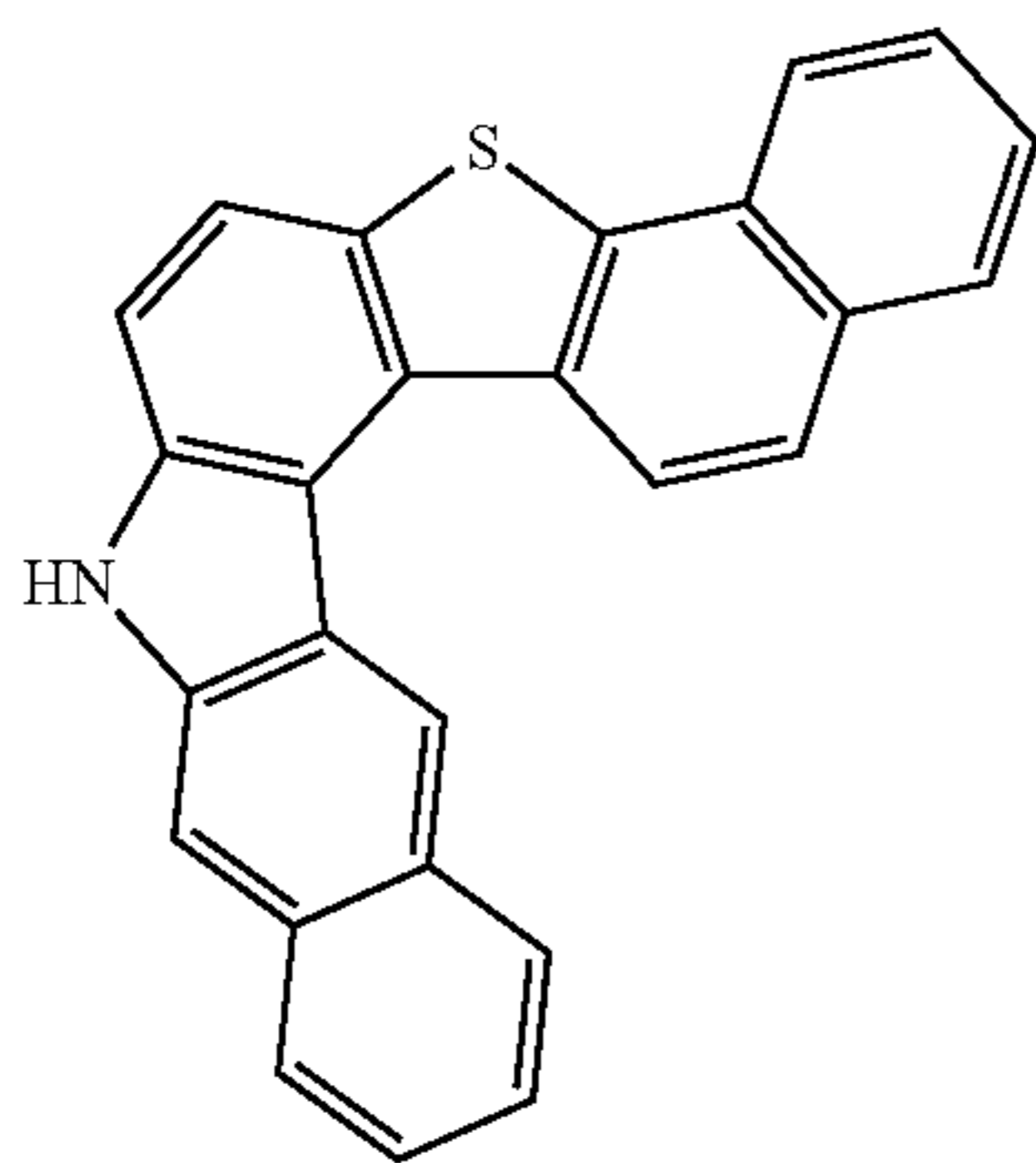
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Sub 3(24)

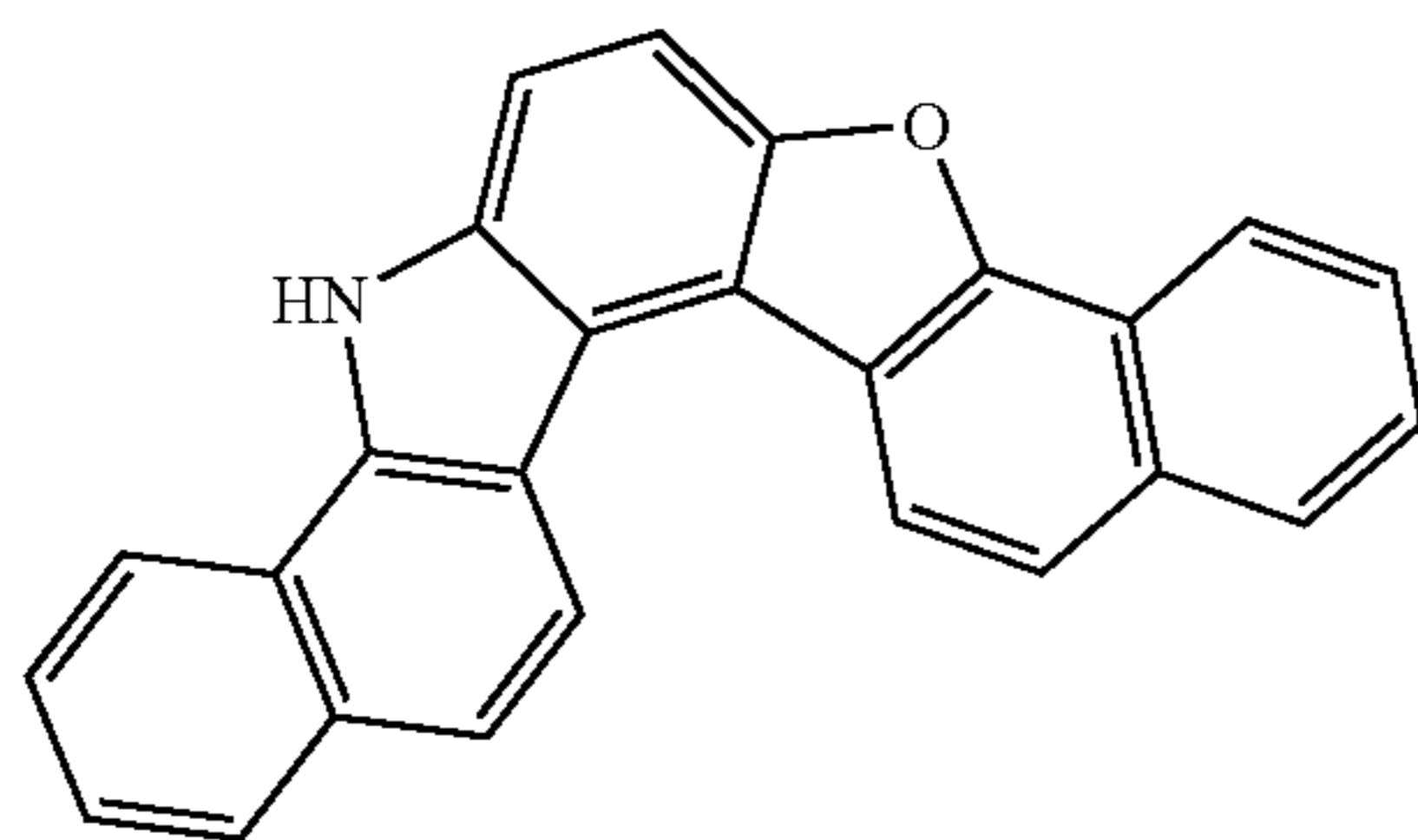


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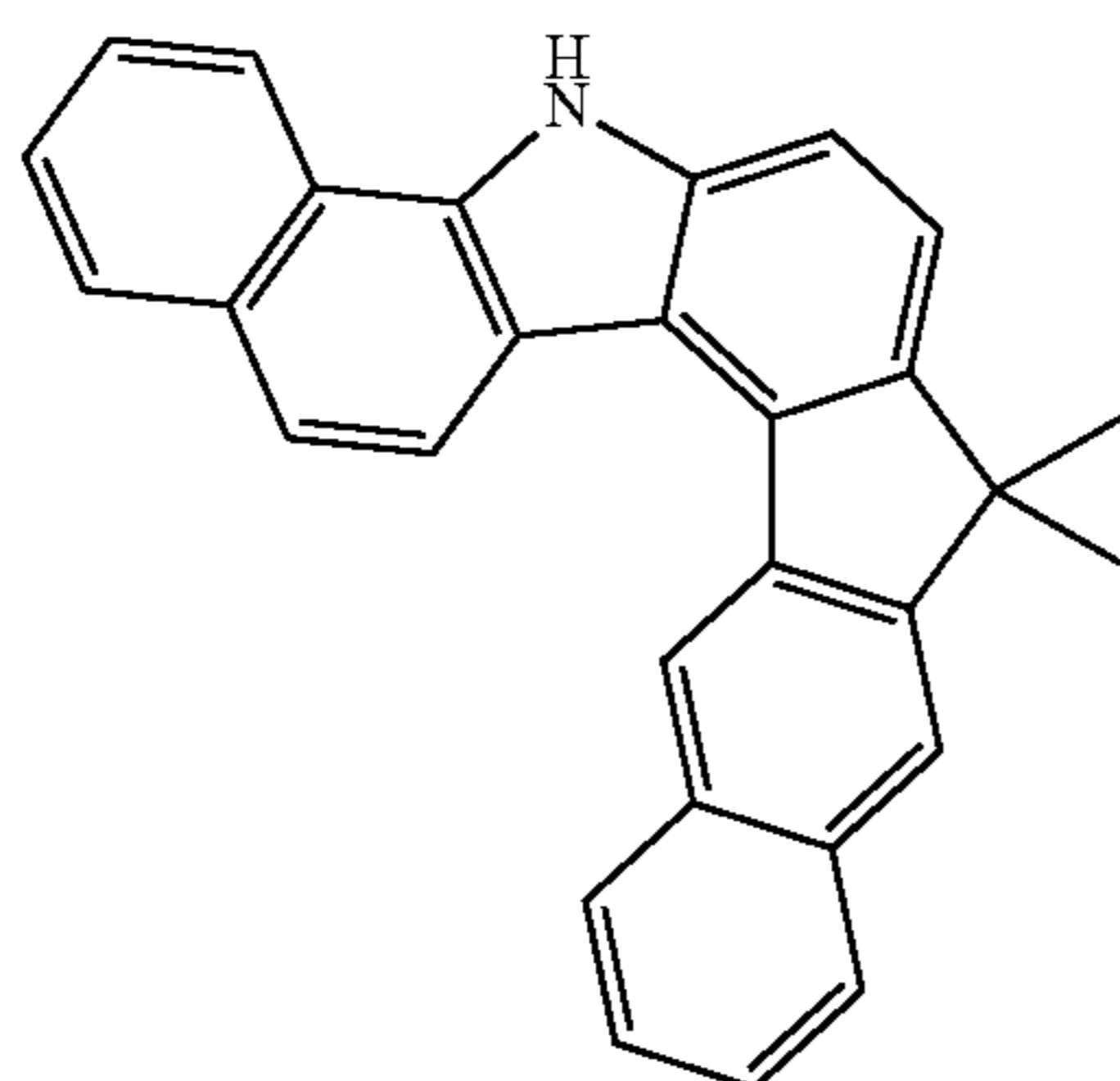
Sub 3(25)



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Sub 3(26)



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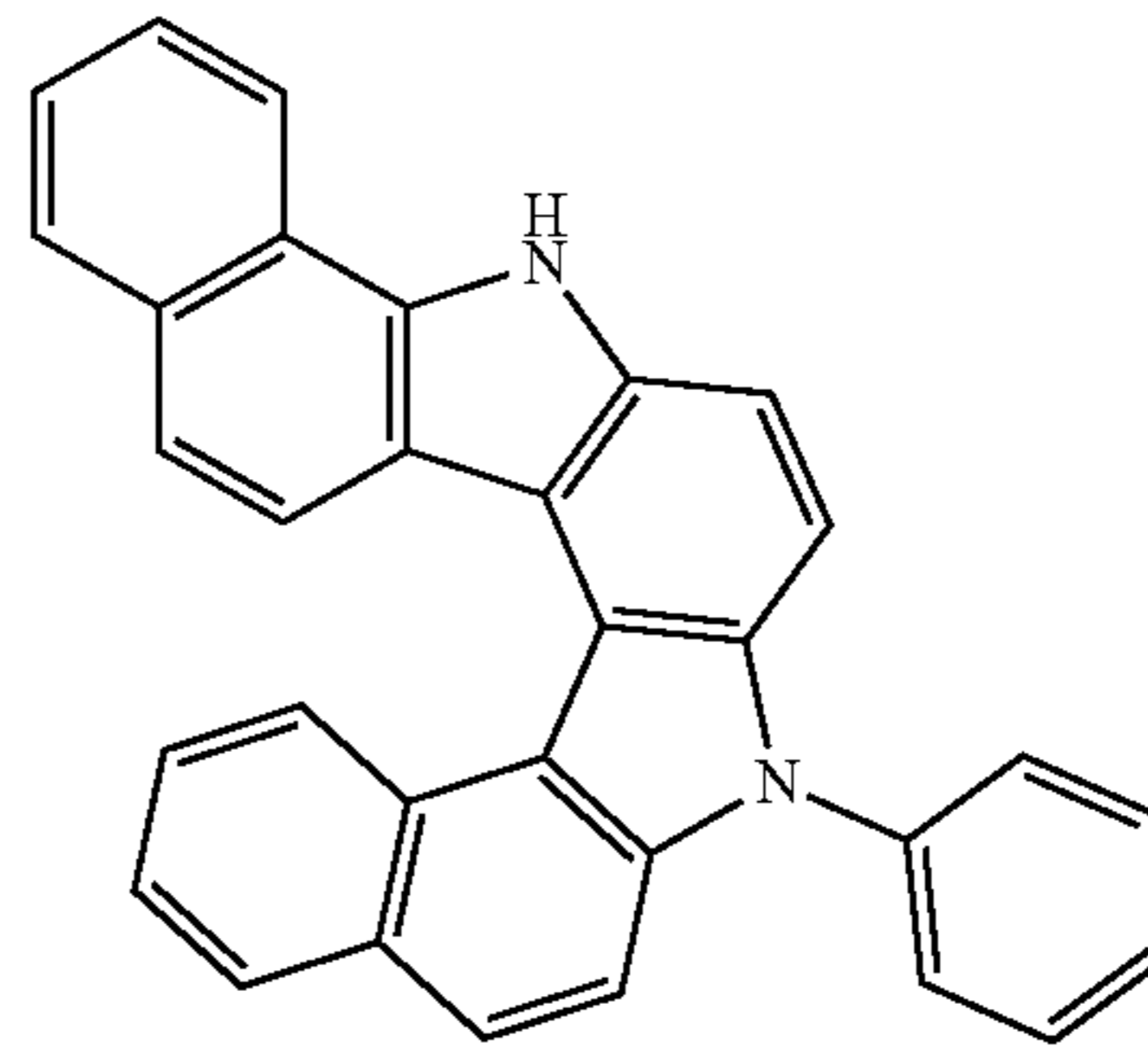
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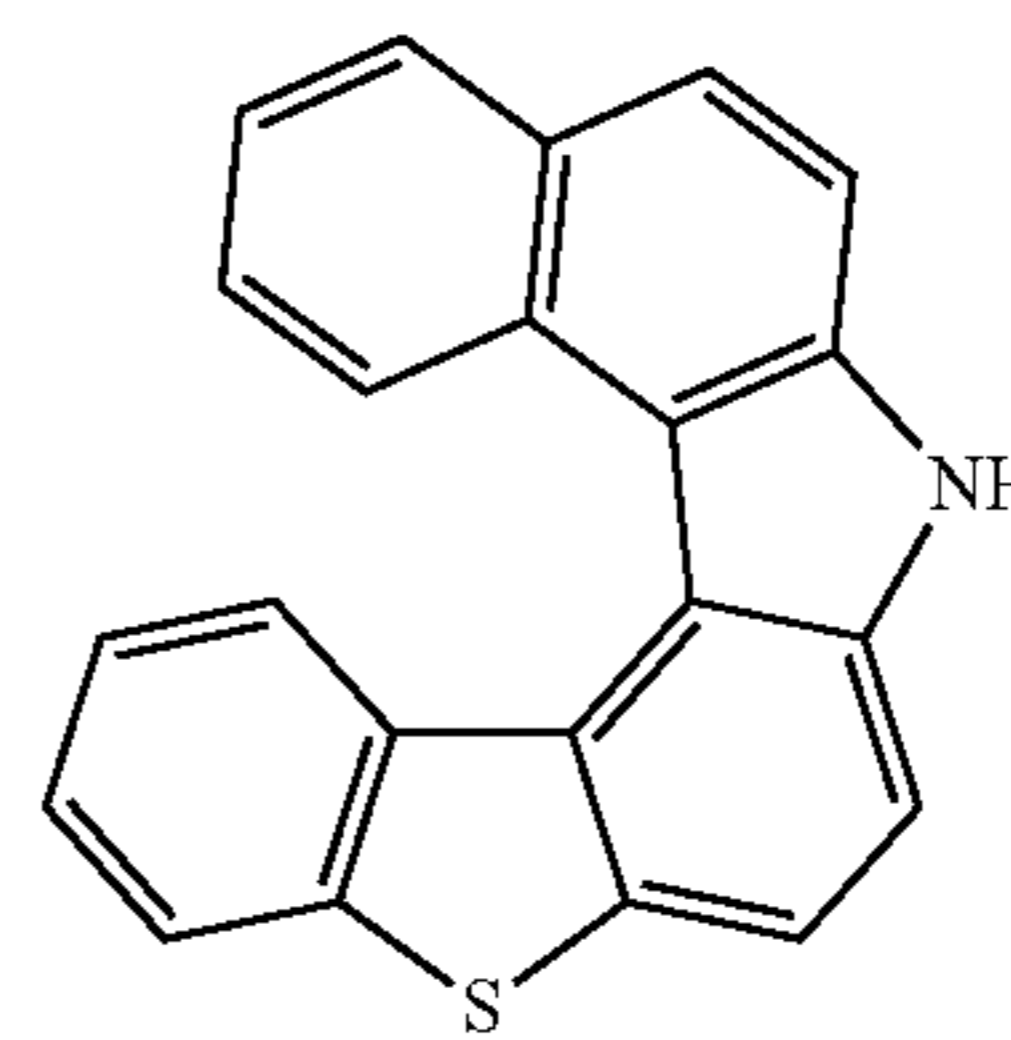
130

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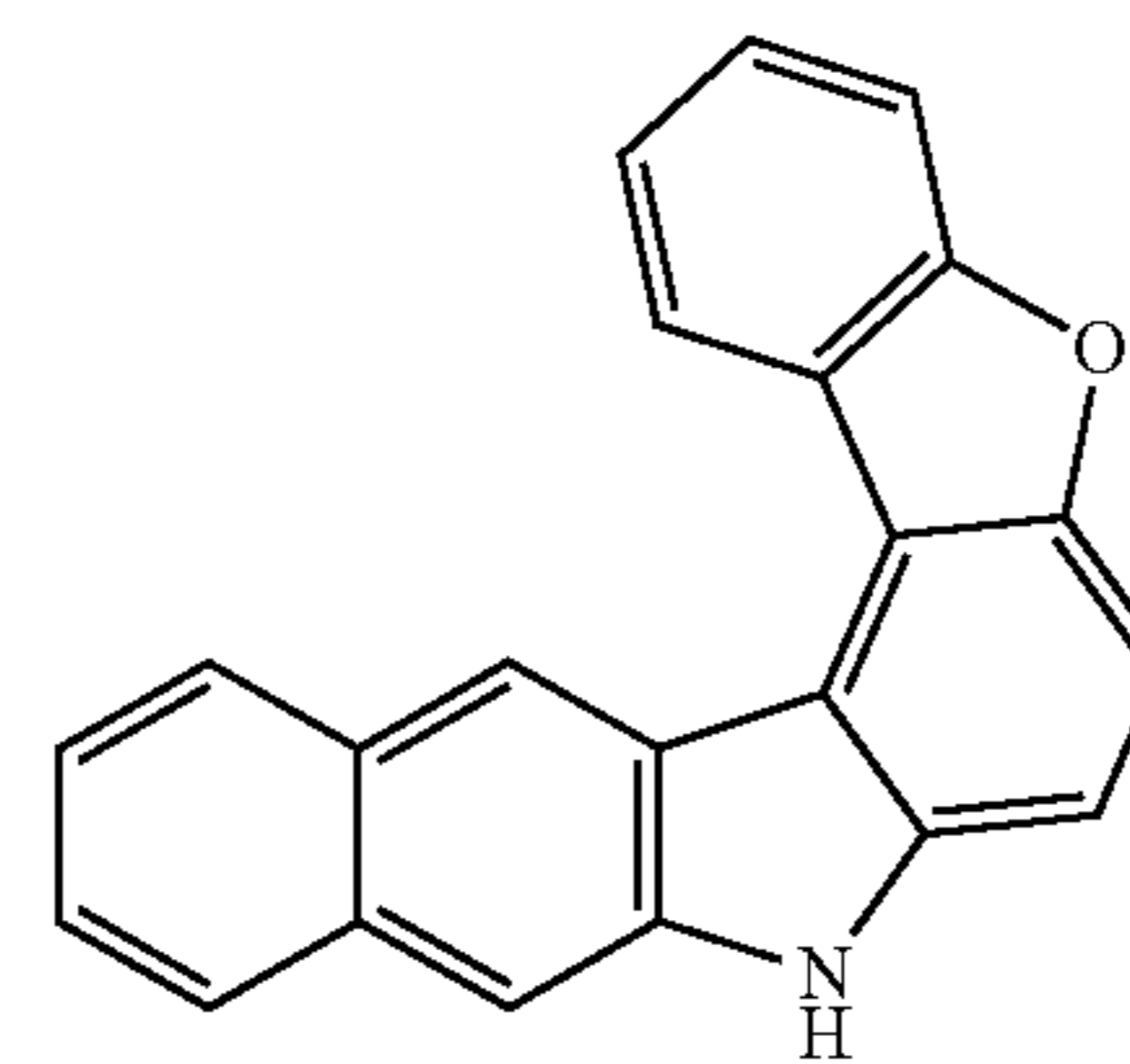
Sub 3(27)



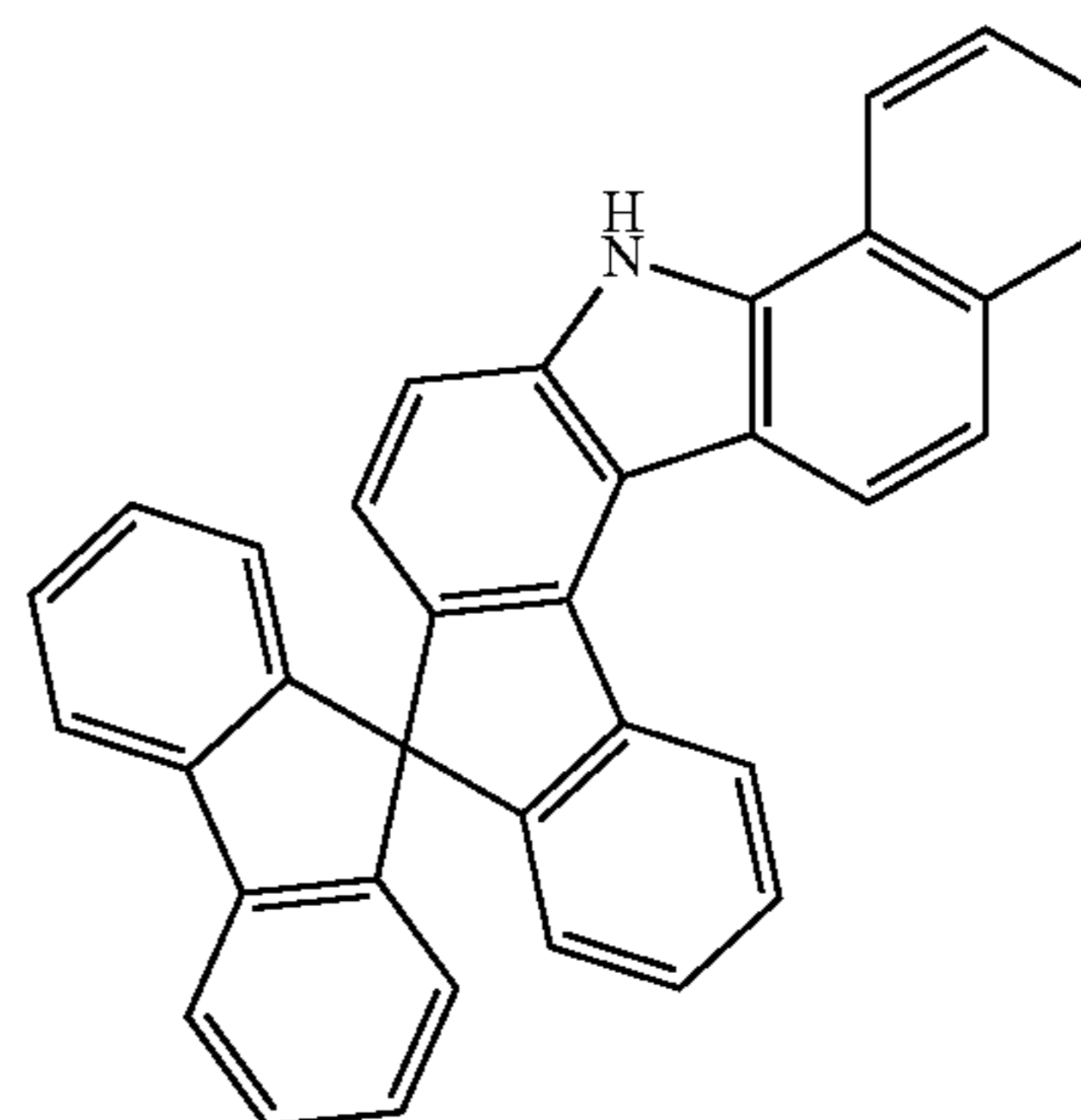
Sub 3(28)



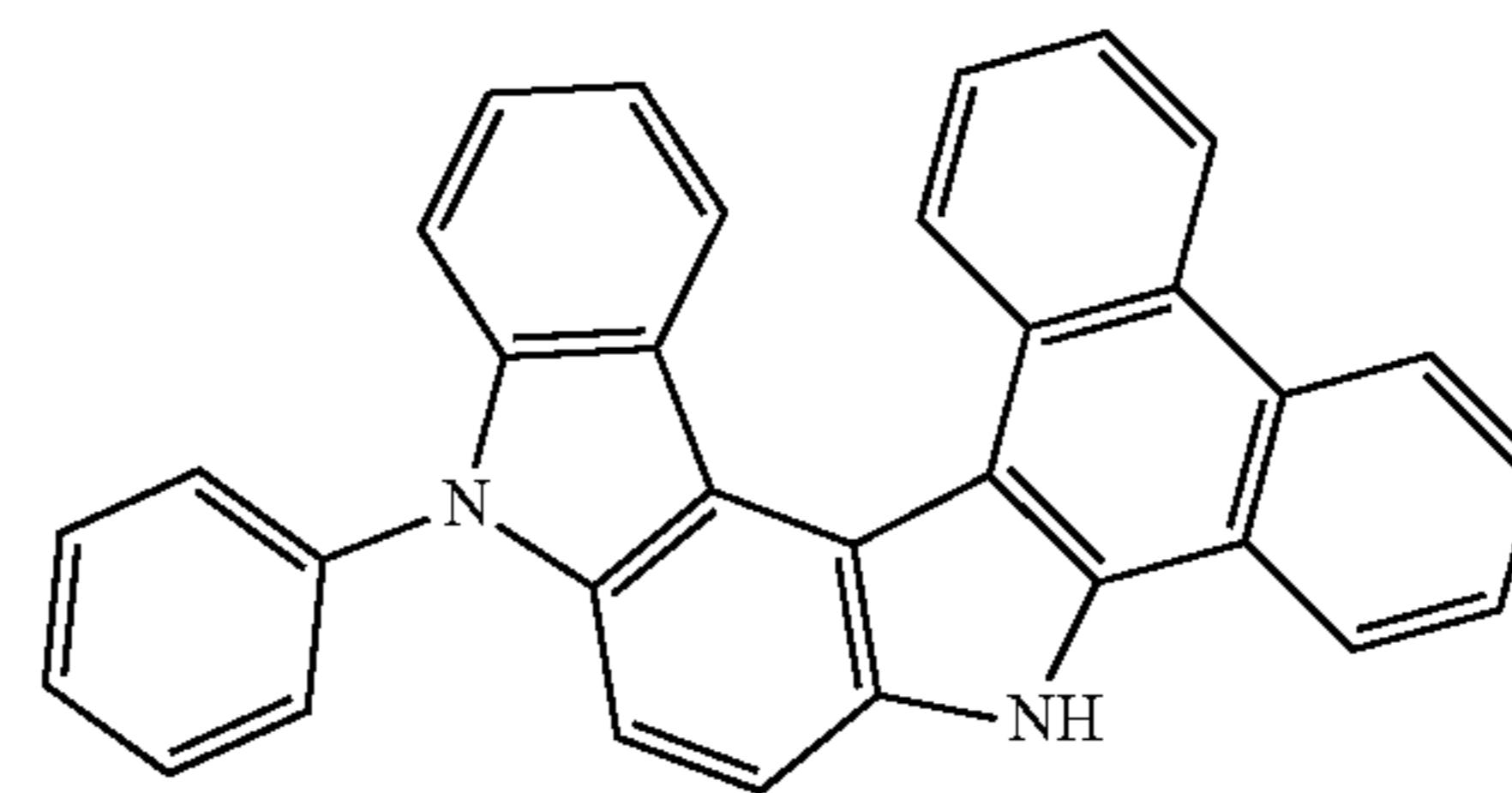
Sub 3(29)



Sub 3(30)

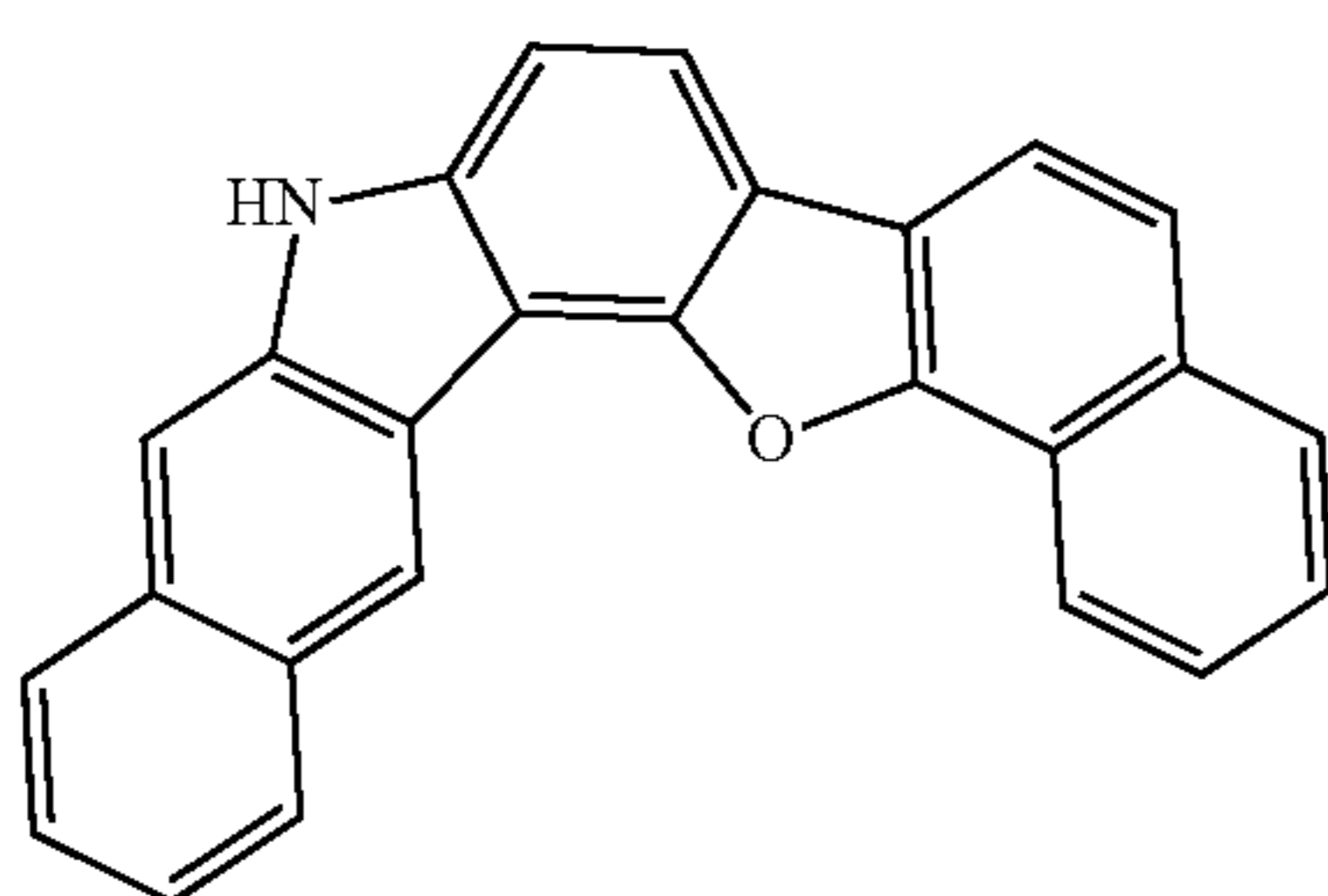
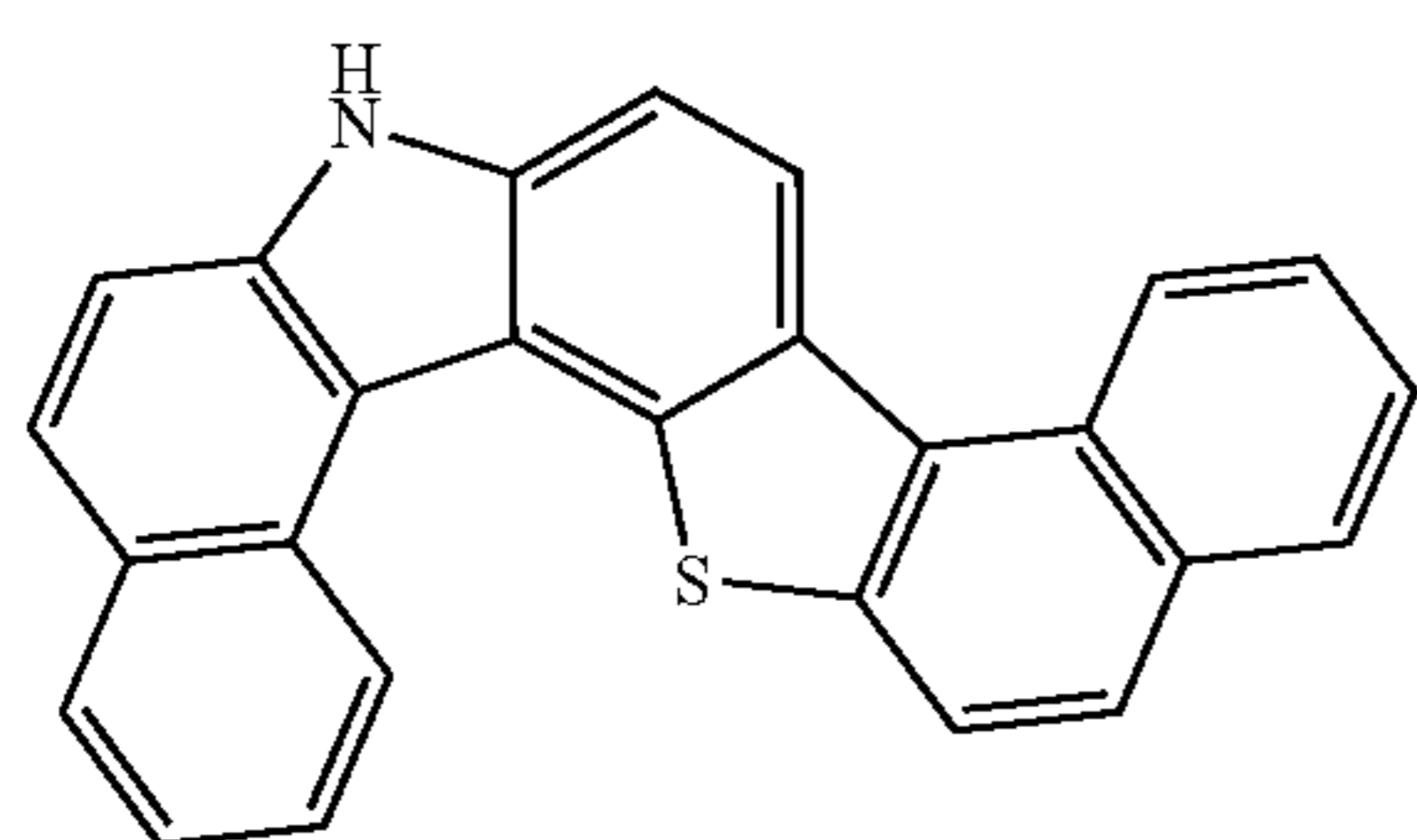
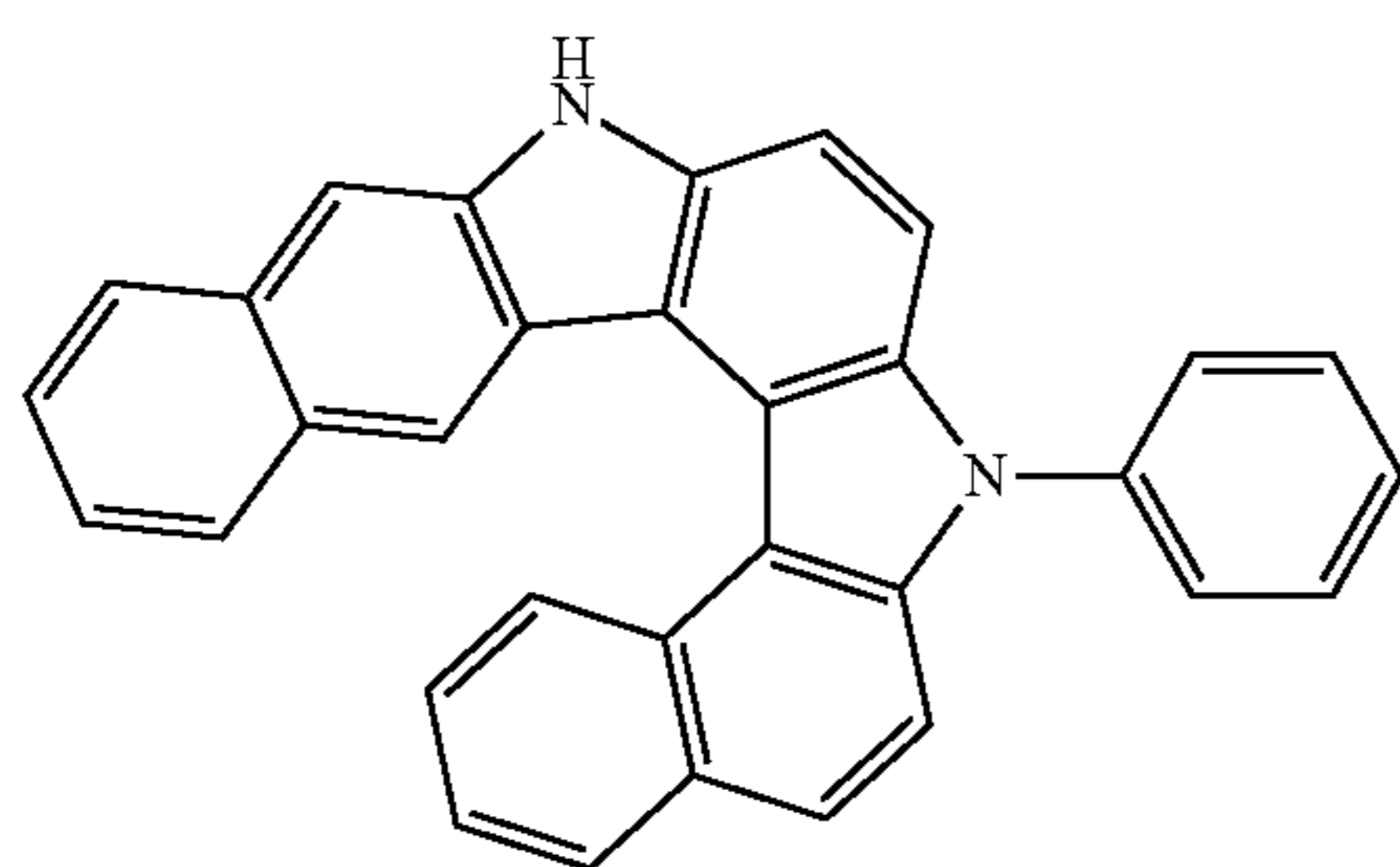
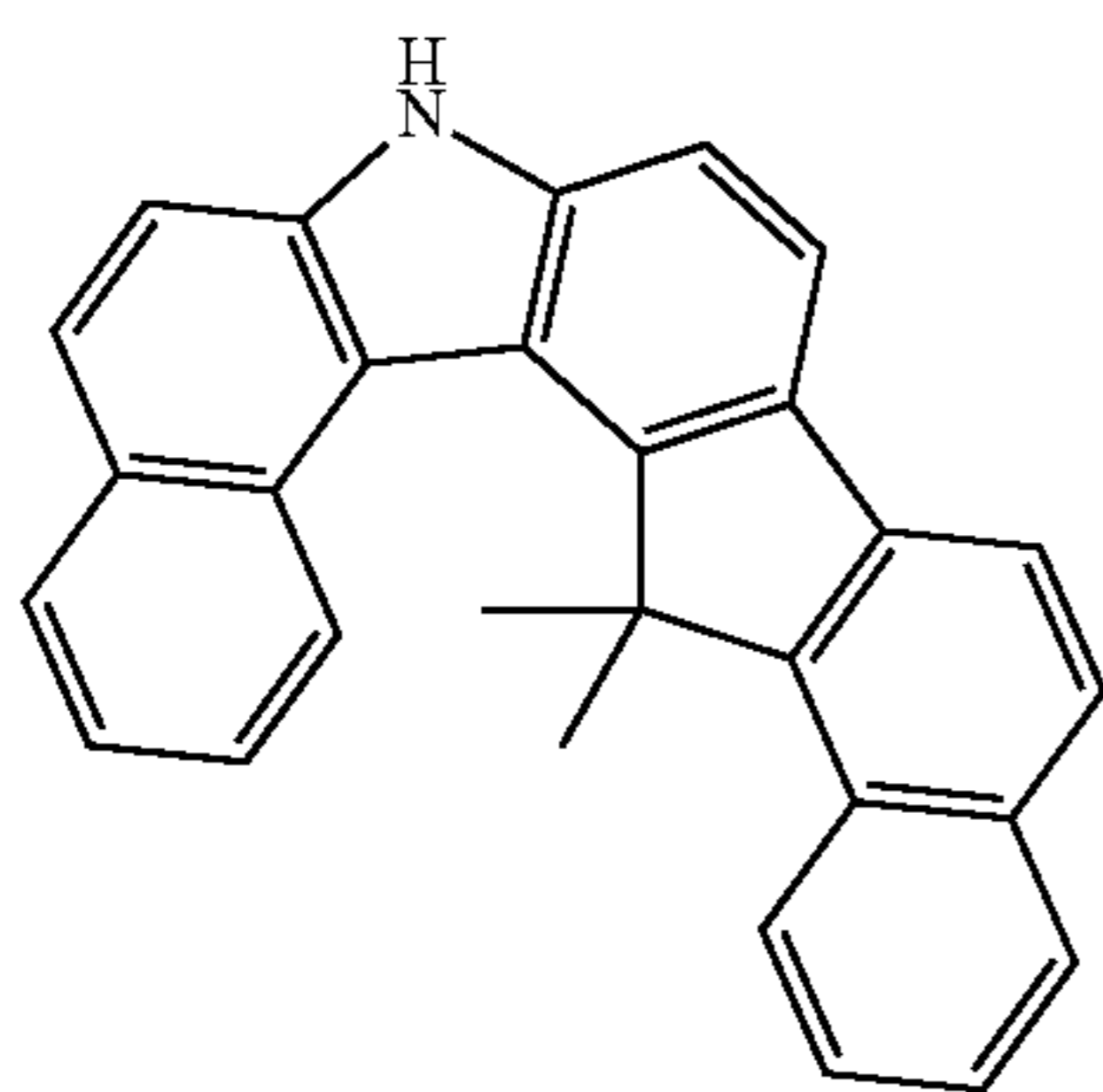
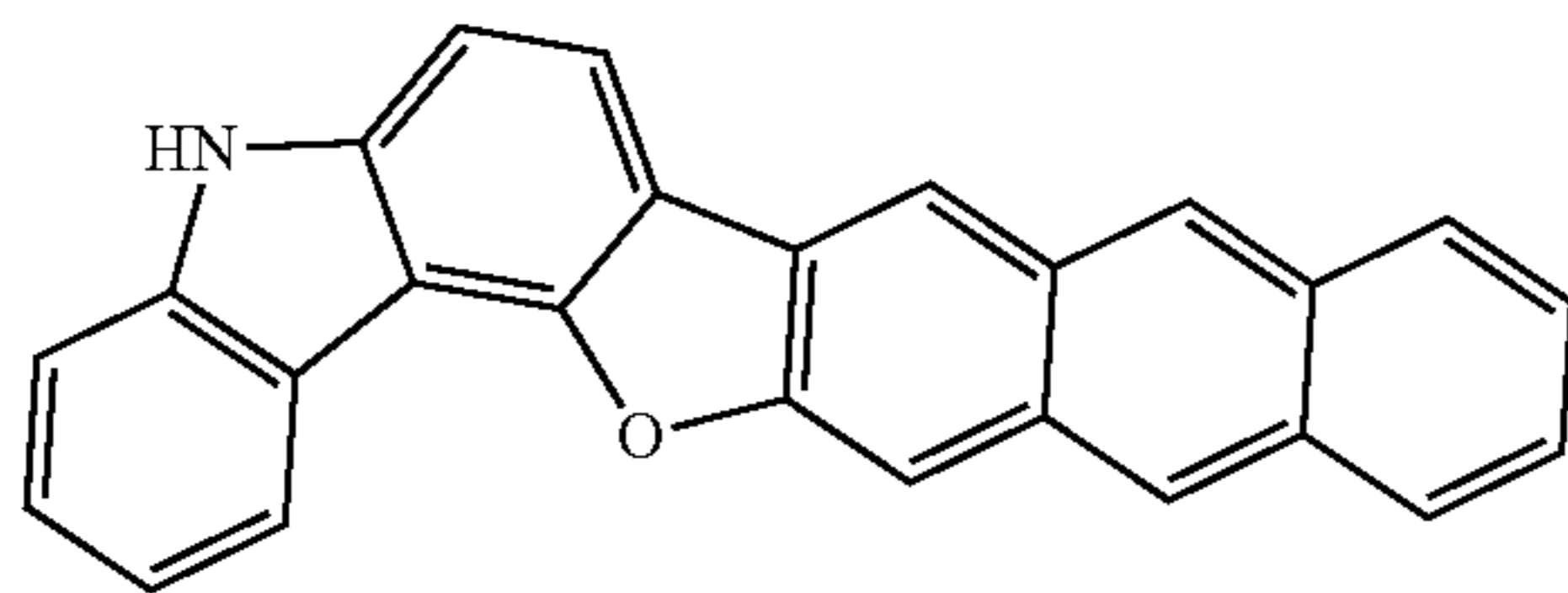
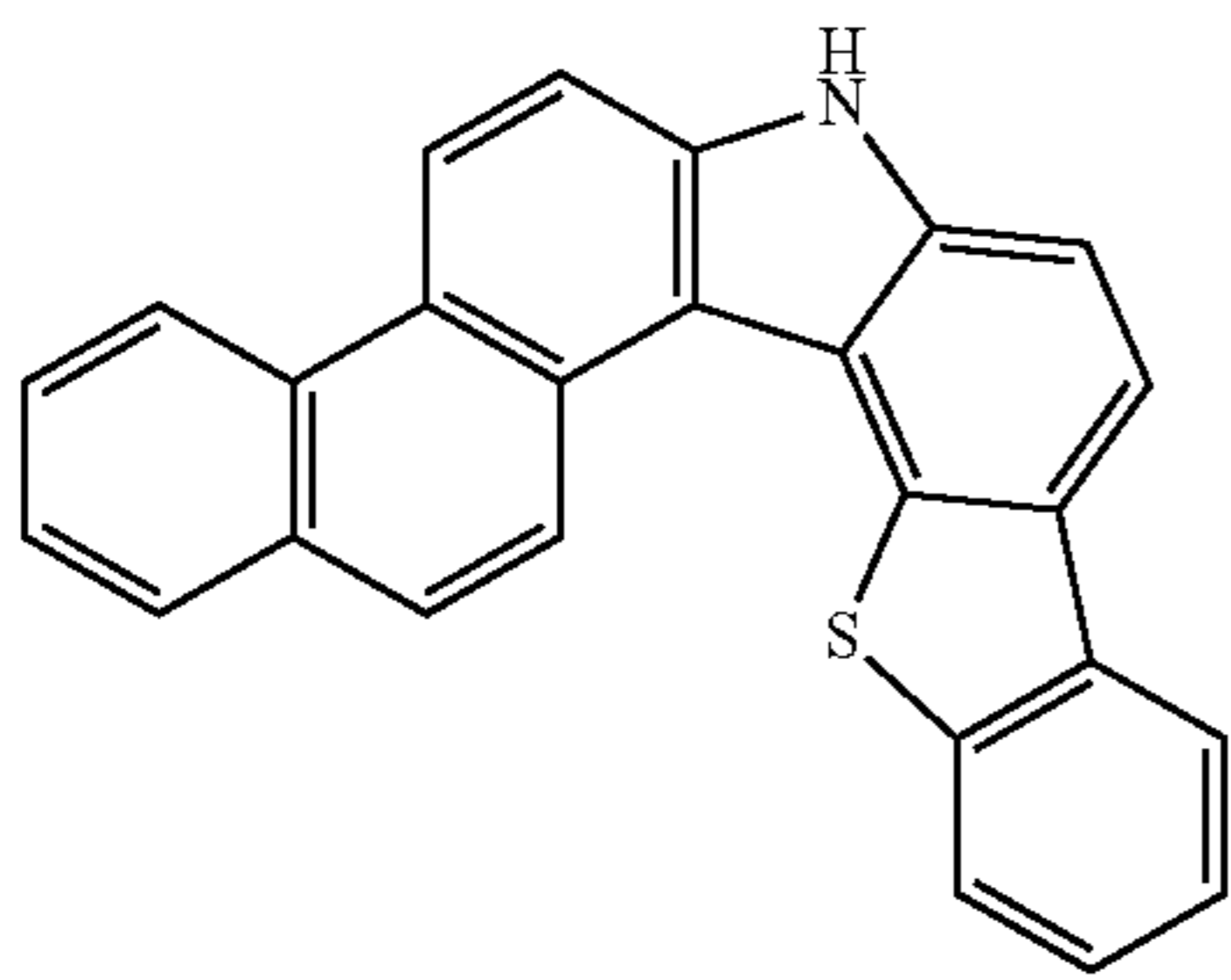


Sub 3(35)



**131**

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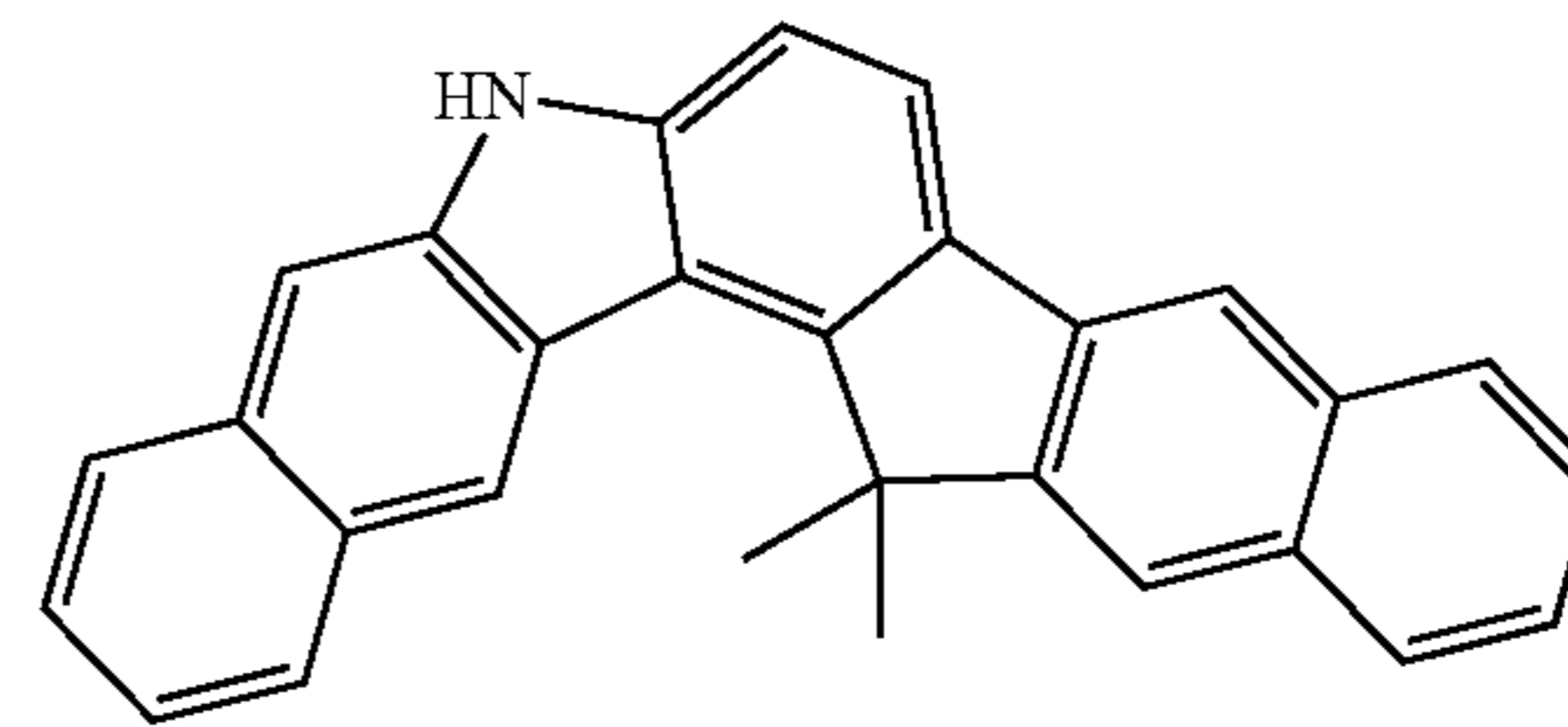


**132**

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Sub 3(36)

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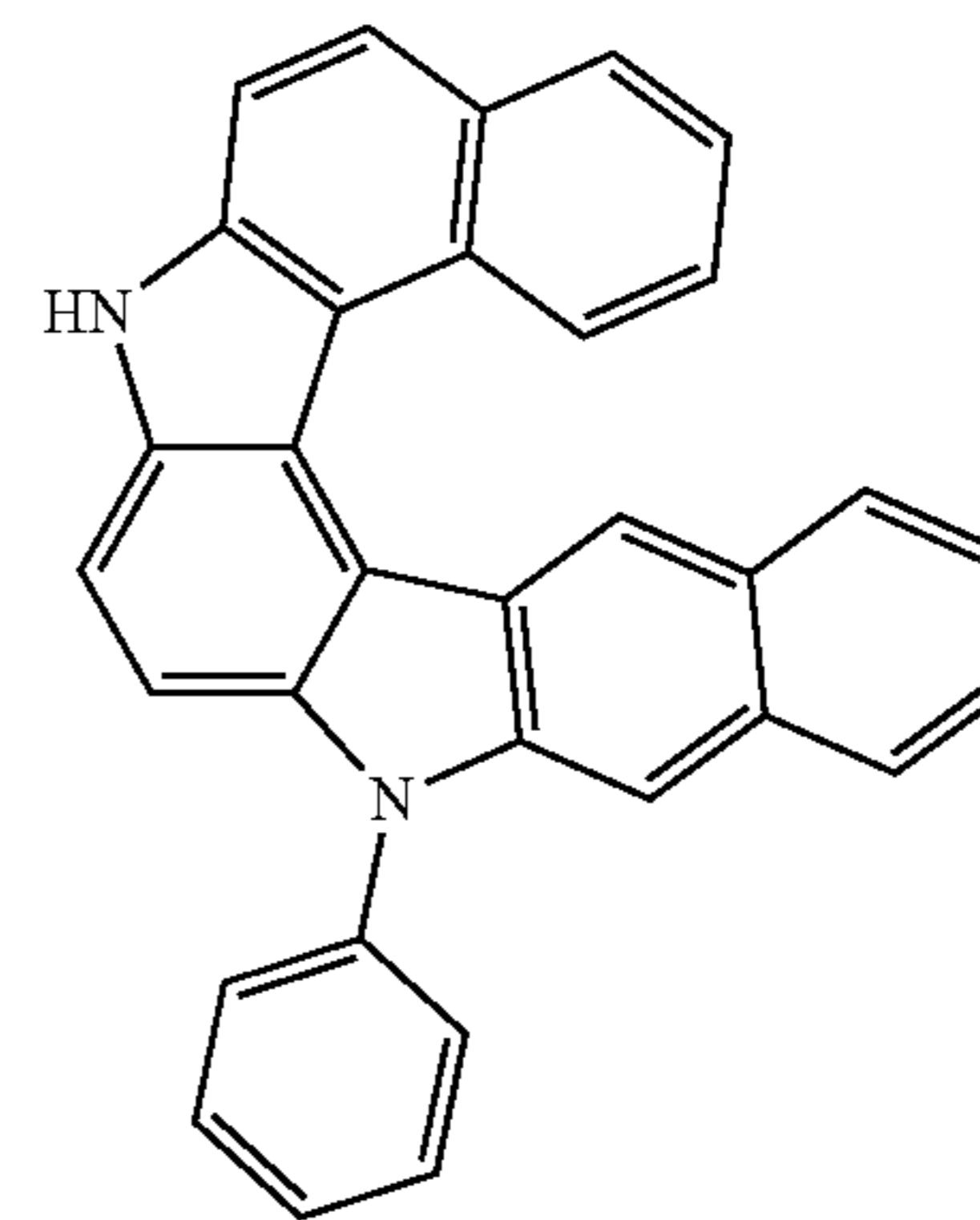


Sub 3(42)

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Sub 3(37)

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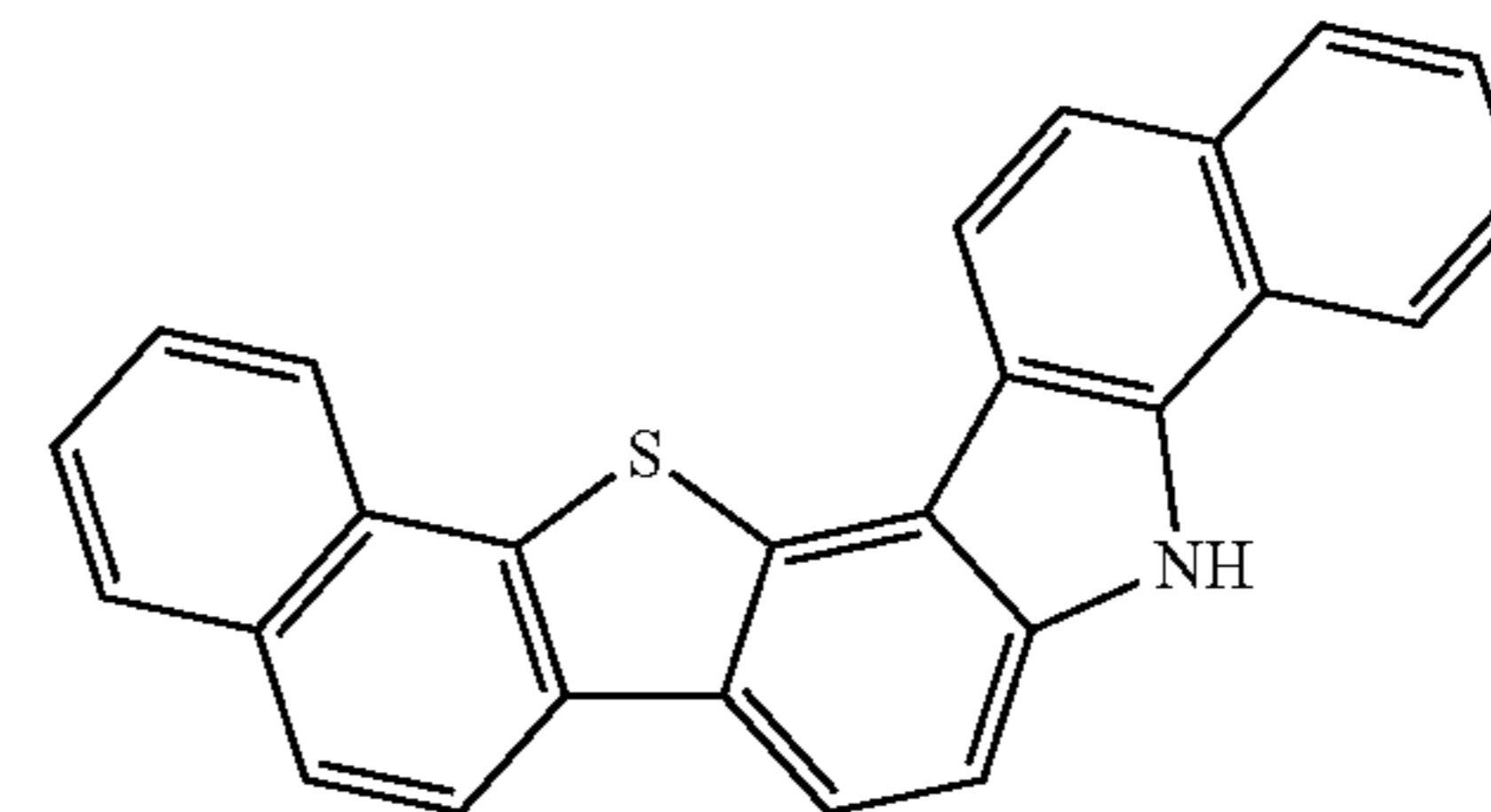


Sub 3(43)

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Sub 3(38)

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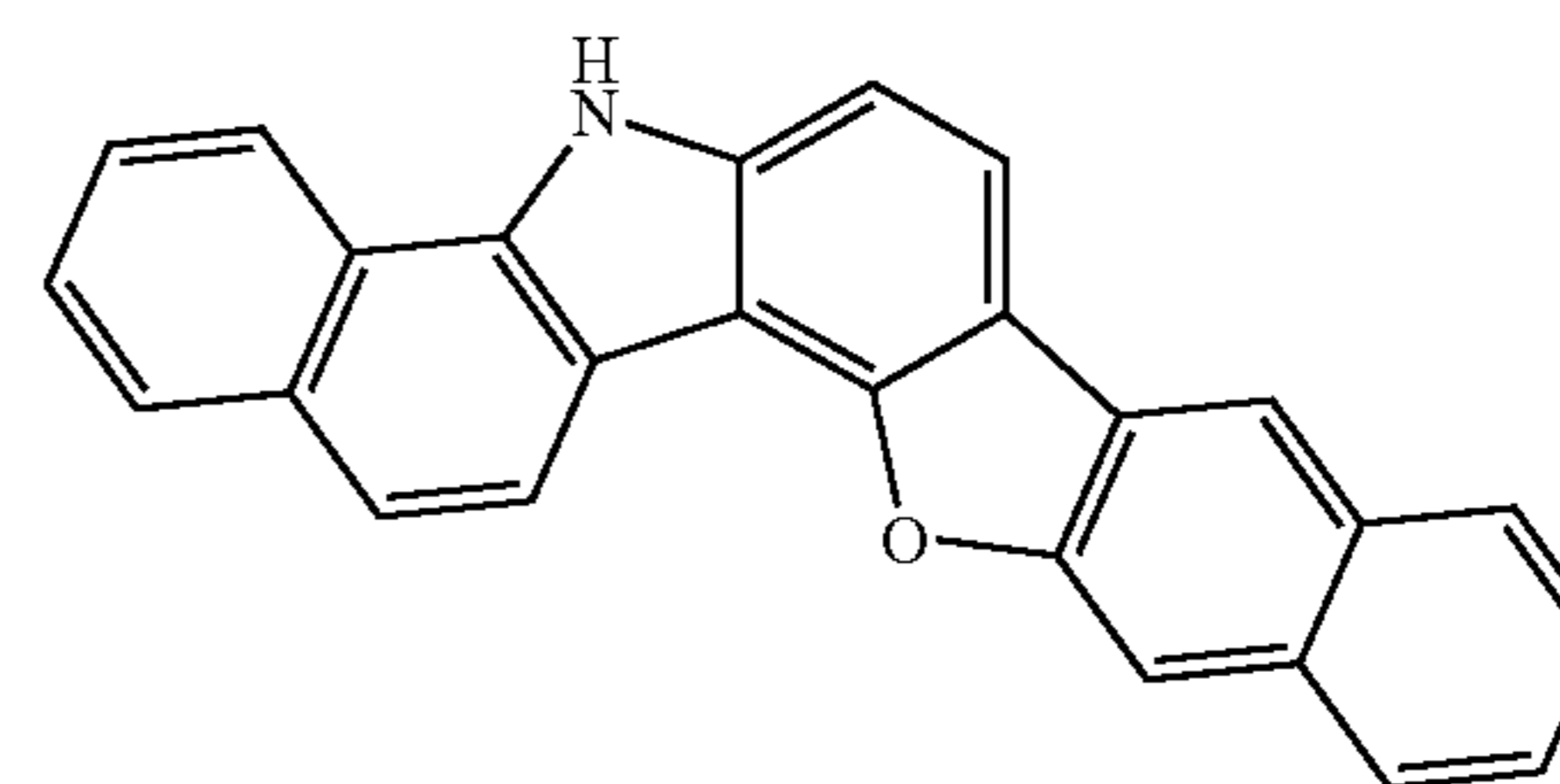


Sub 3(44)

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Sub 3(39)

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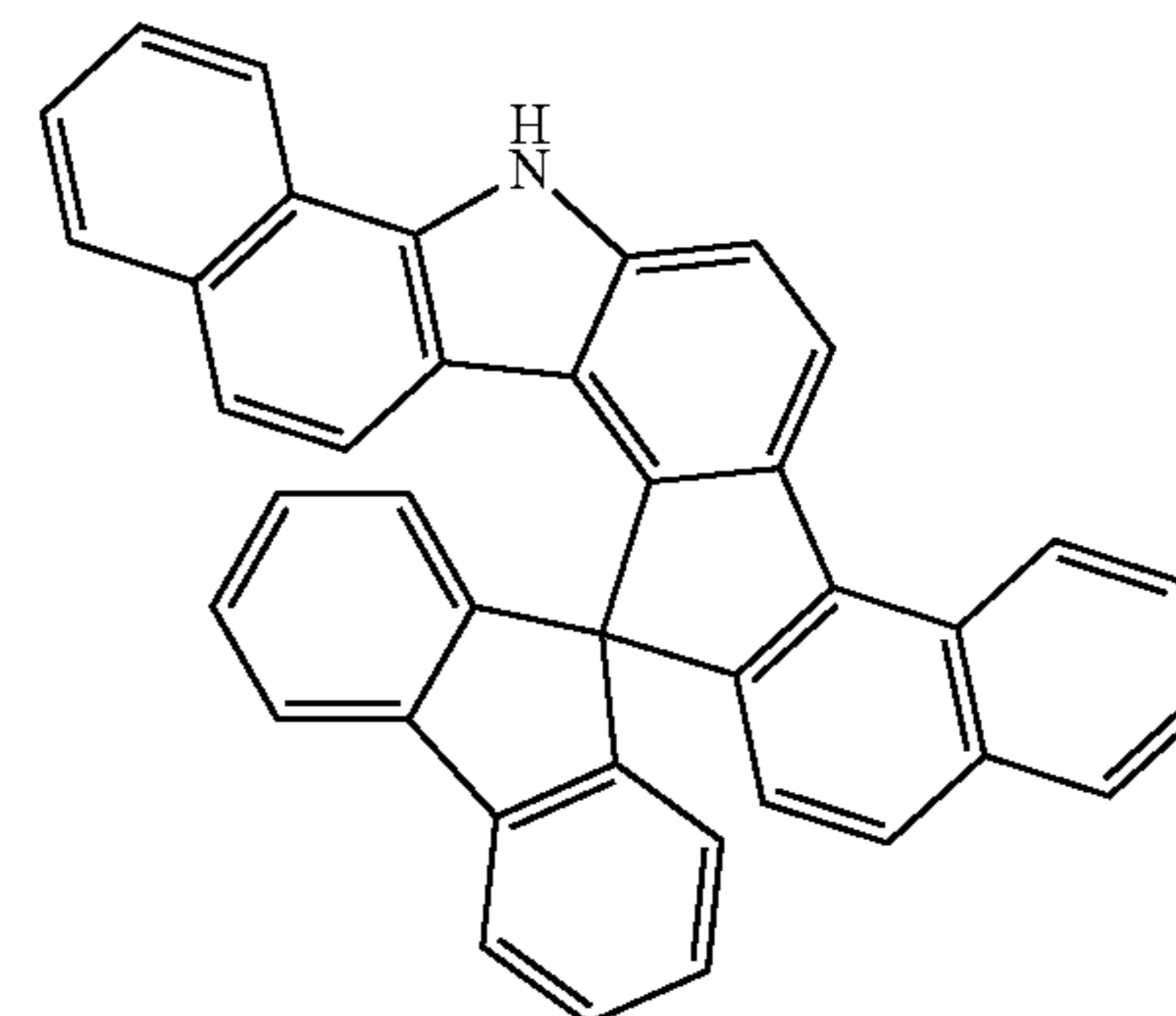


Sub 3(45)

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Sub 3(40)

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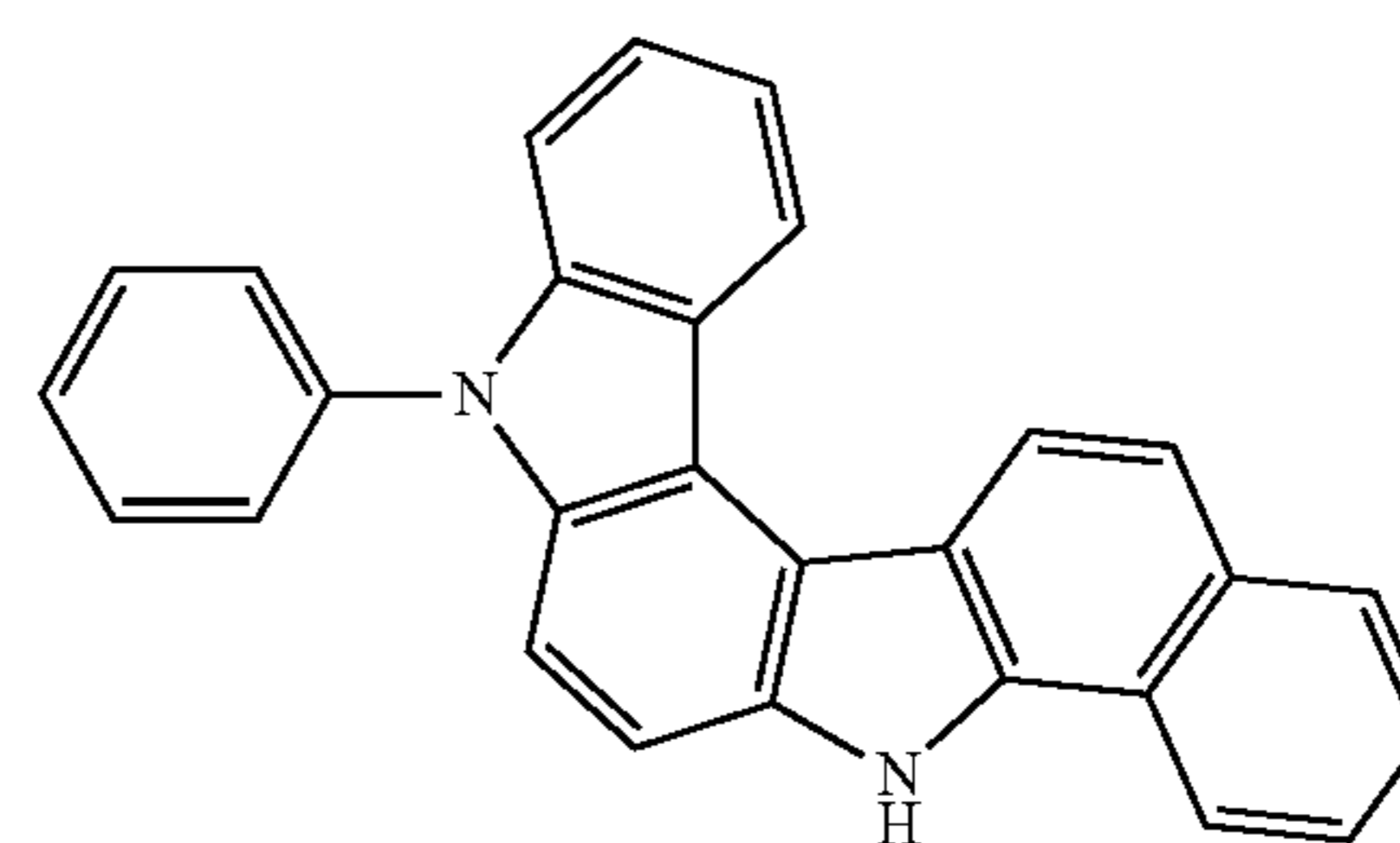
Sub 3(46)

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Sub 3(41)

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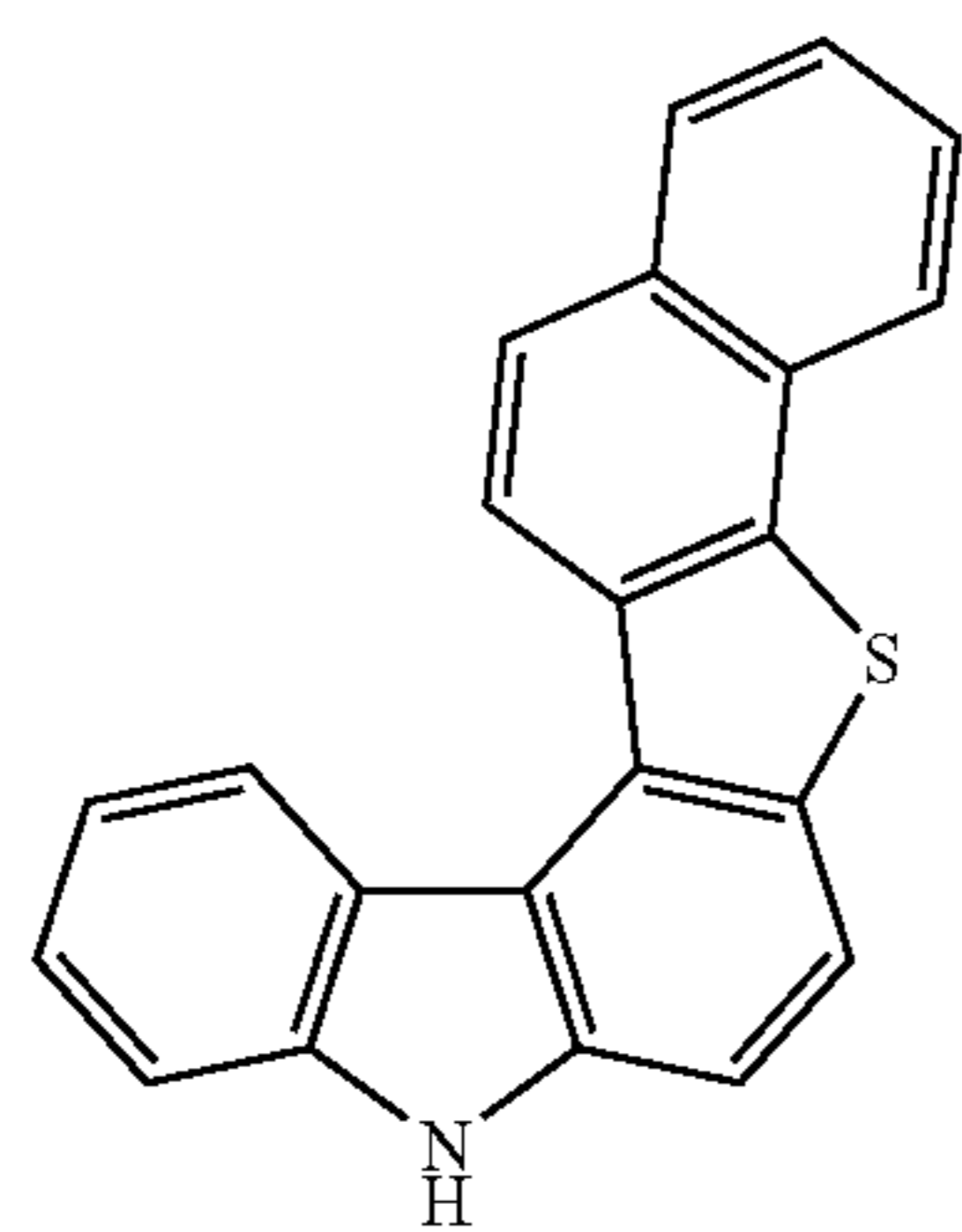
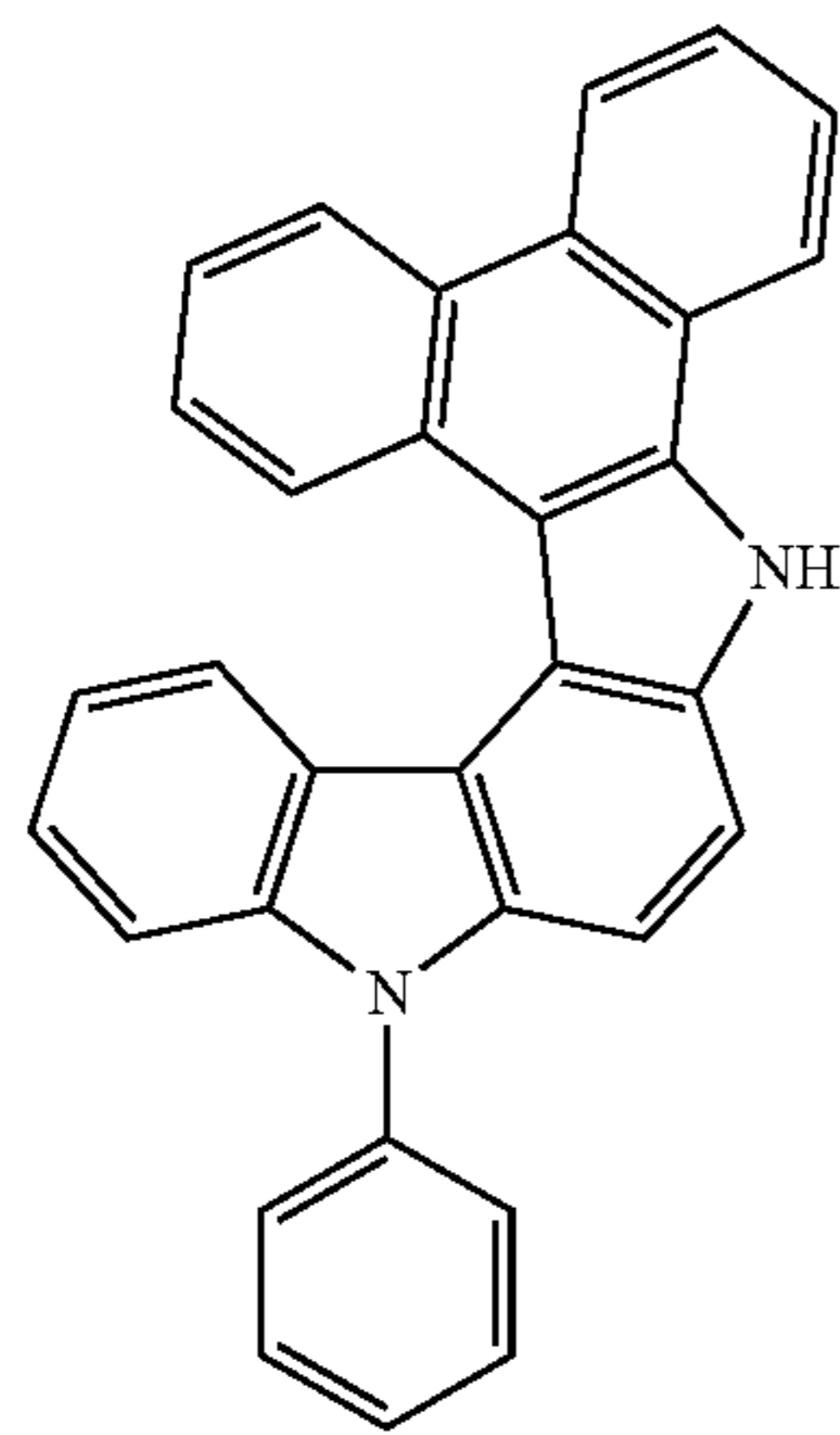
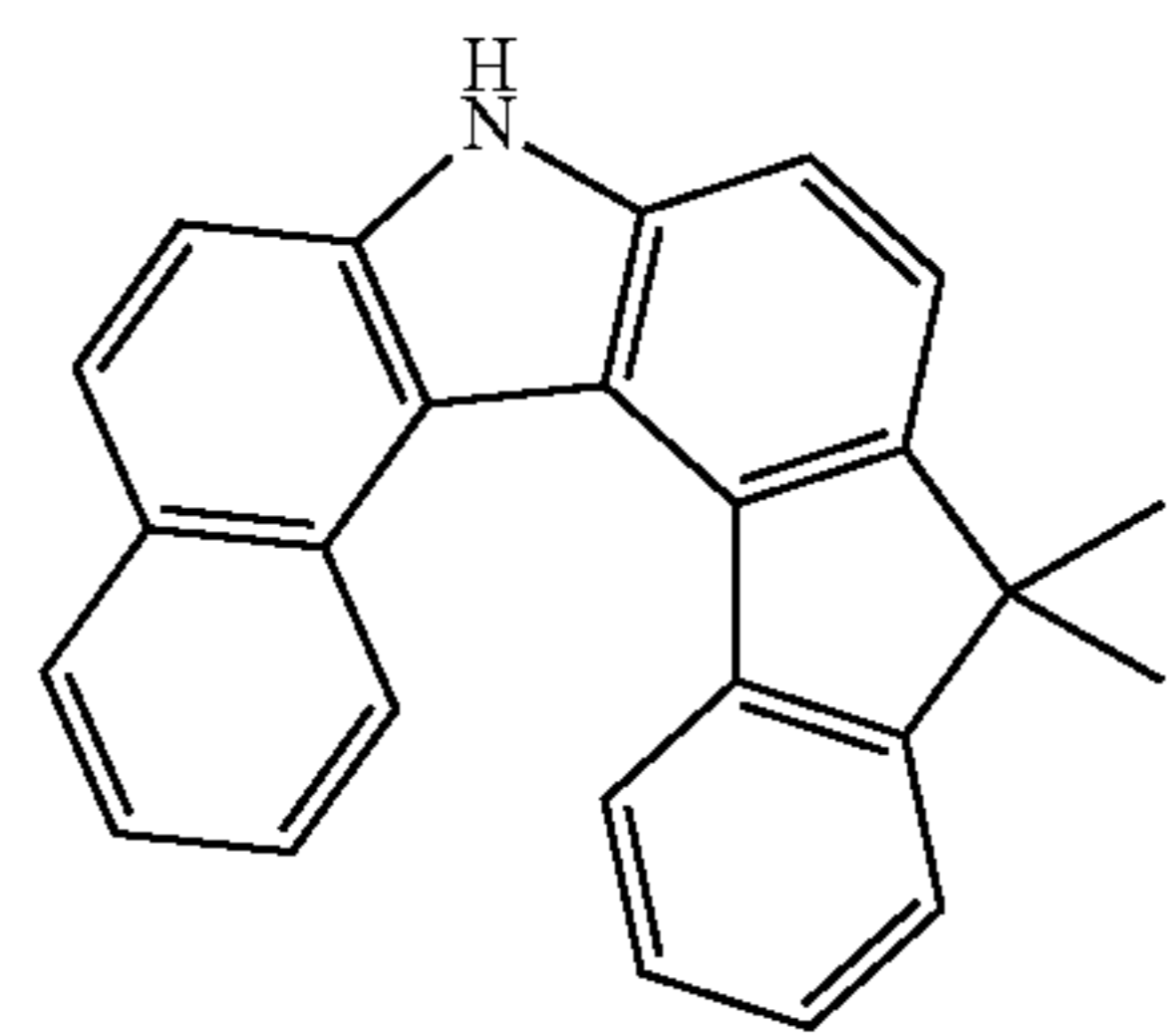
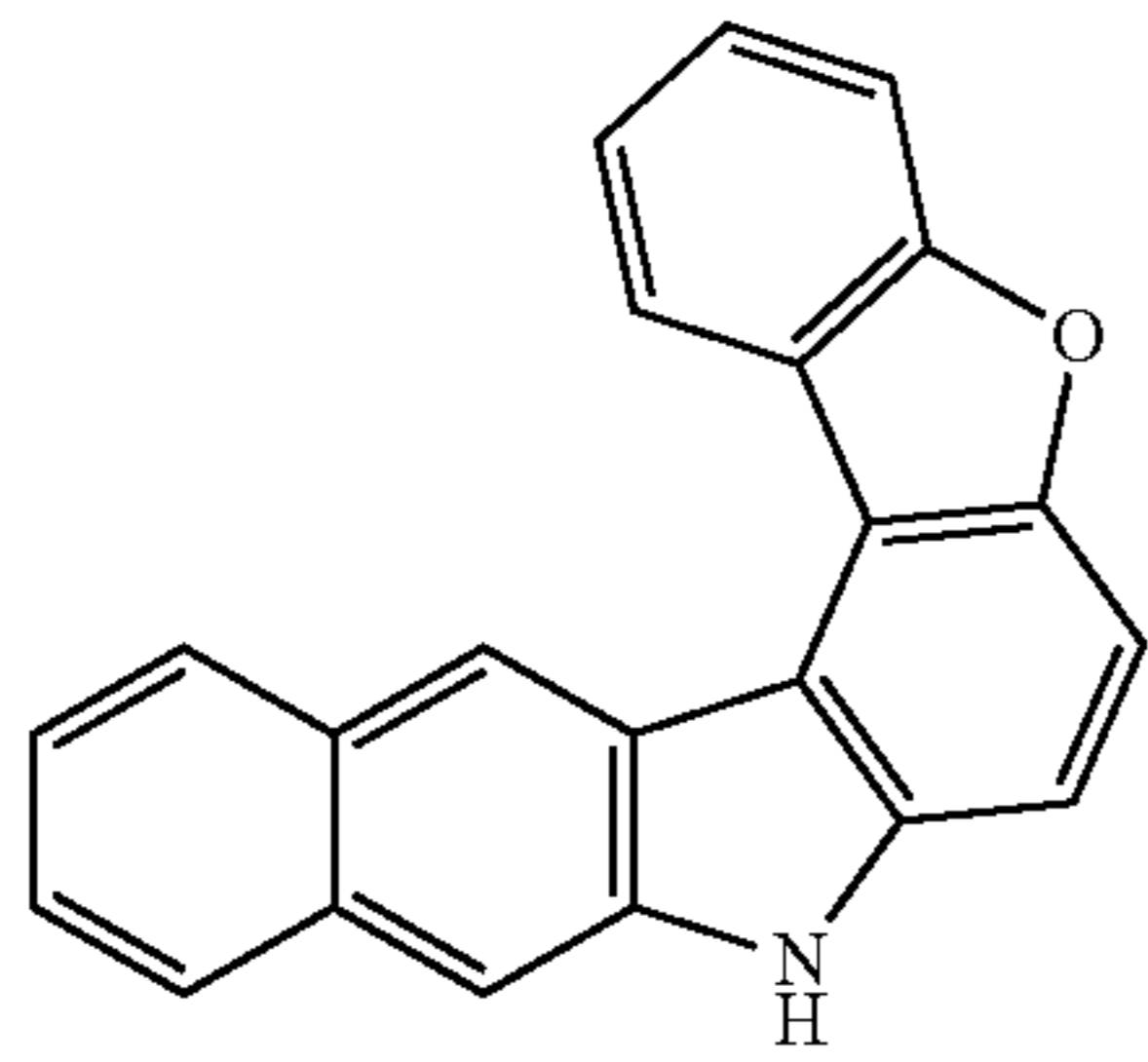
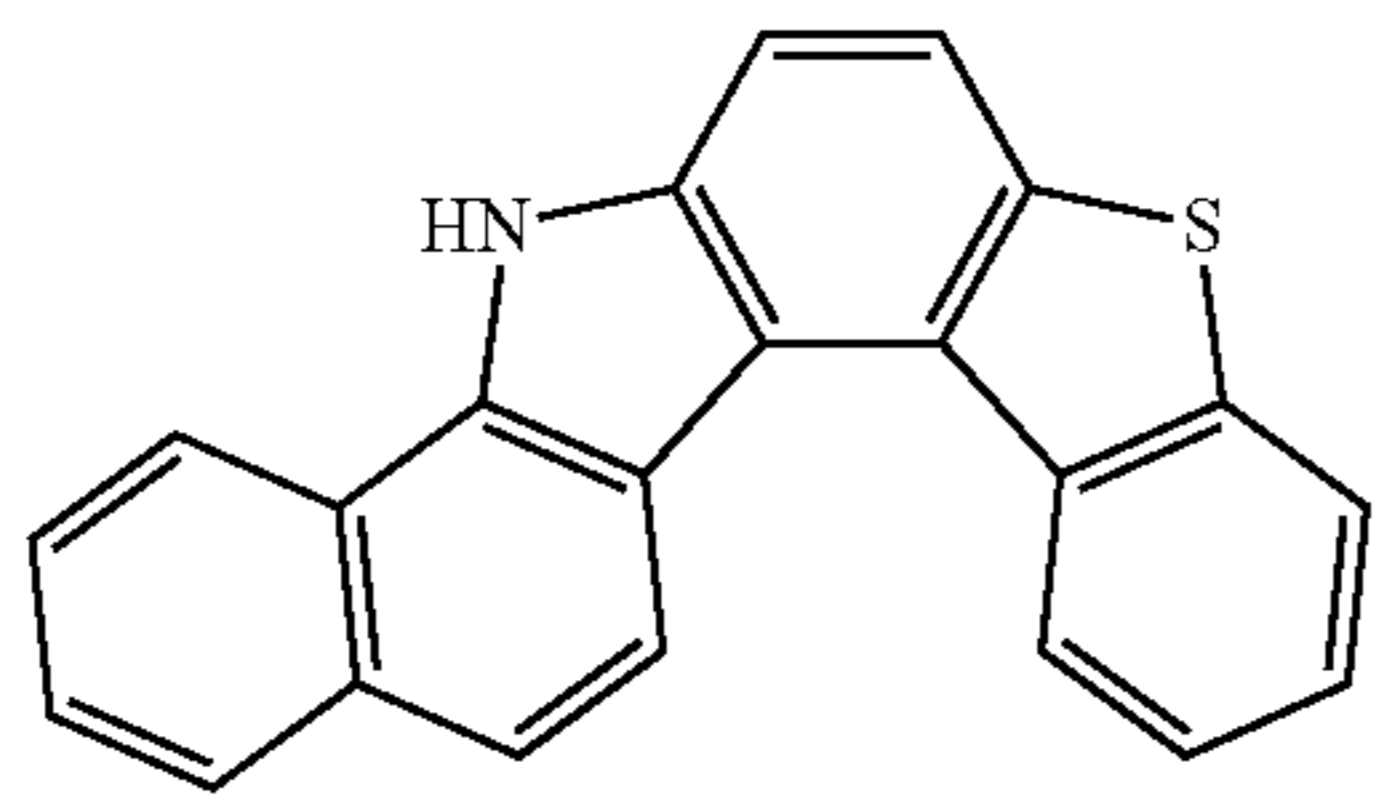


Sub 3(47)

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**133**

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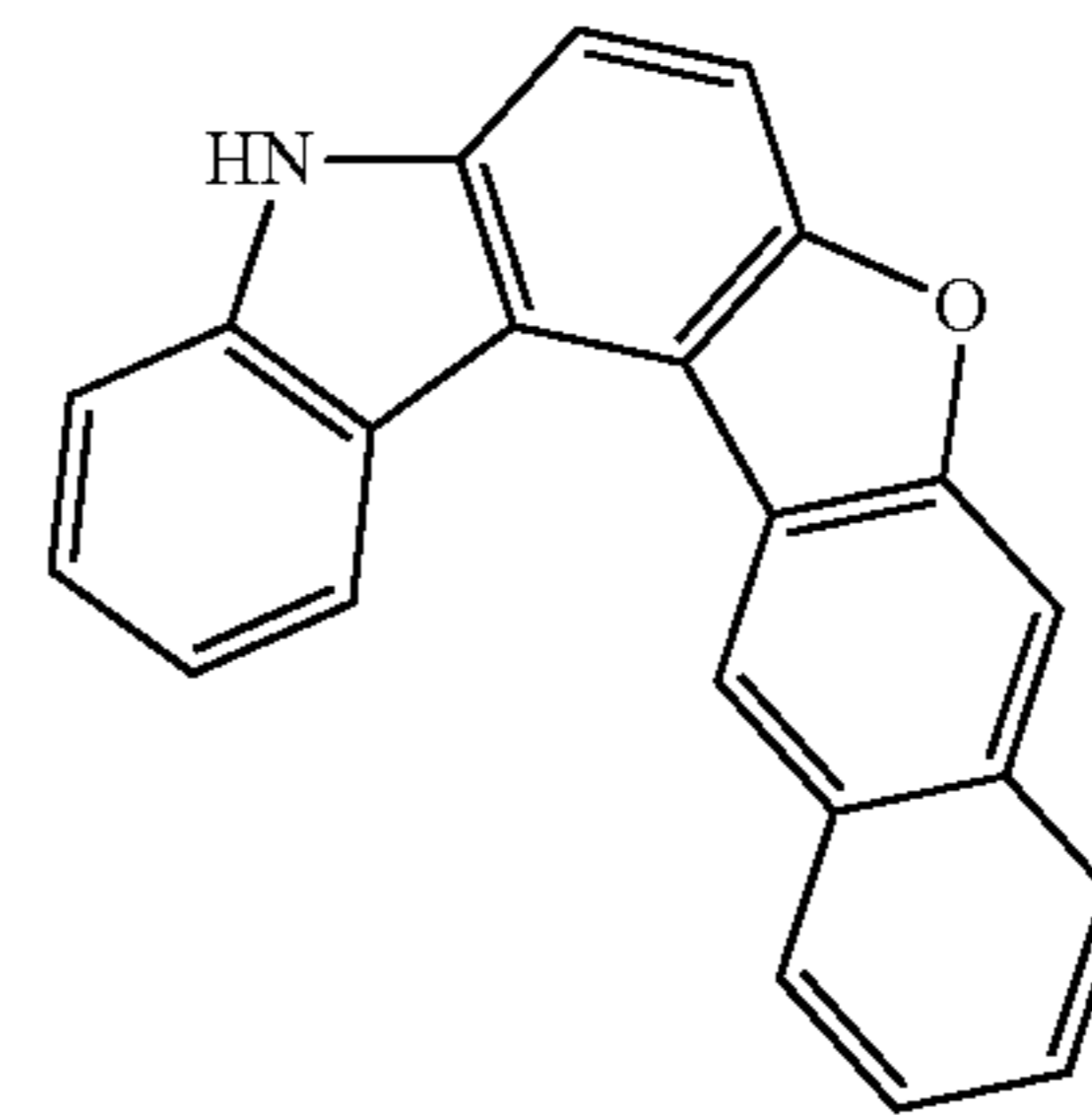


**134**

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Sub 3(48)

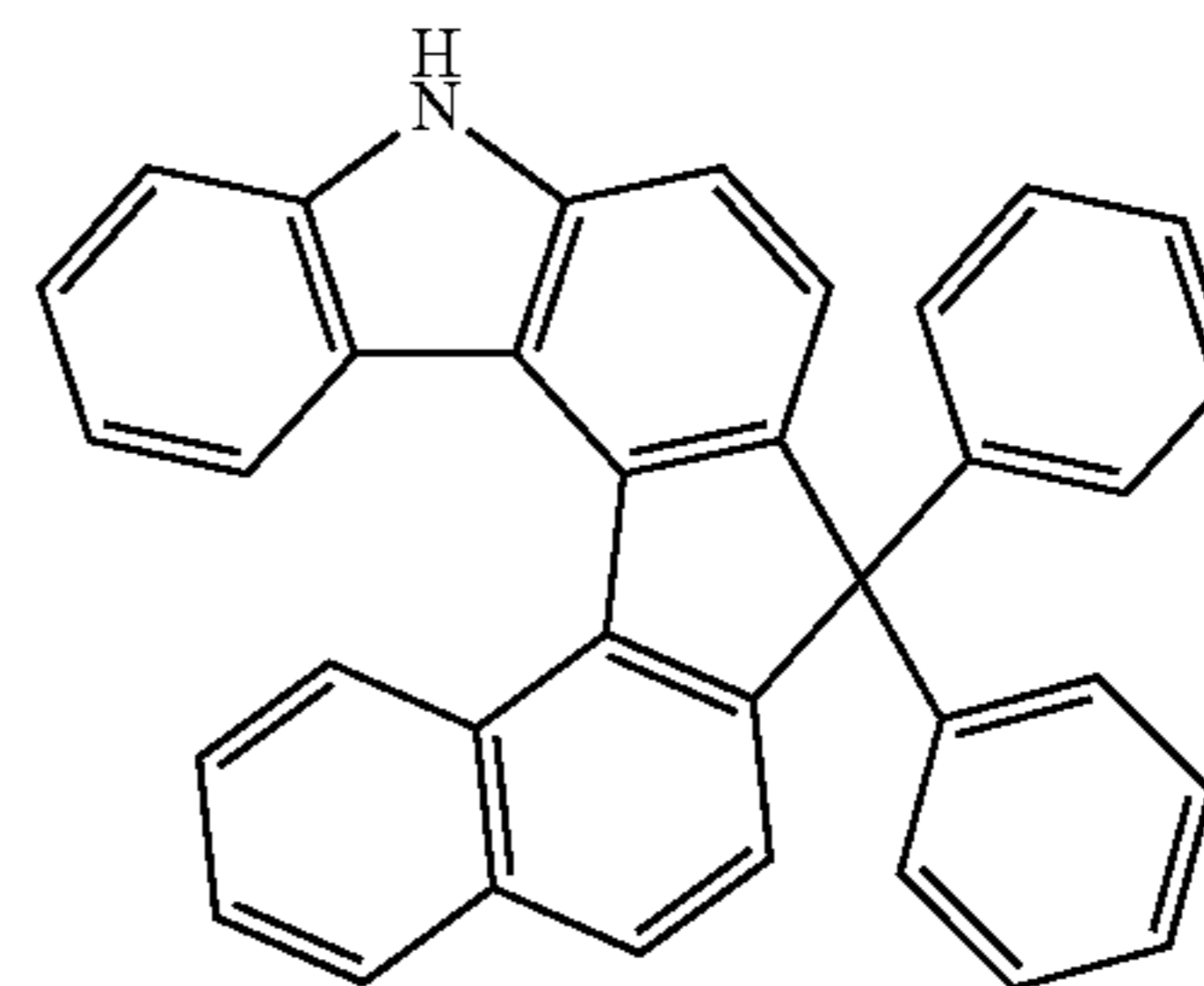
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Sub 3(49)

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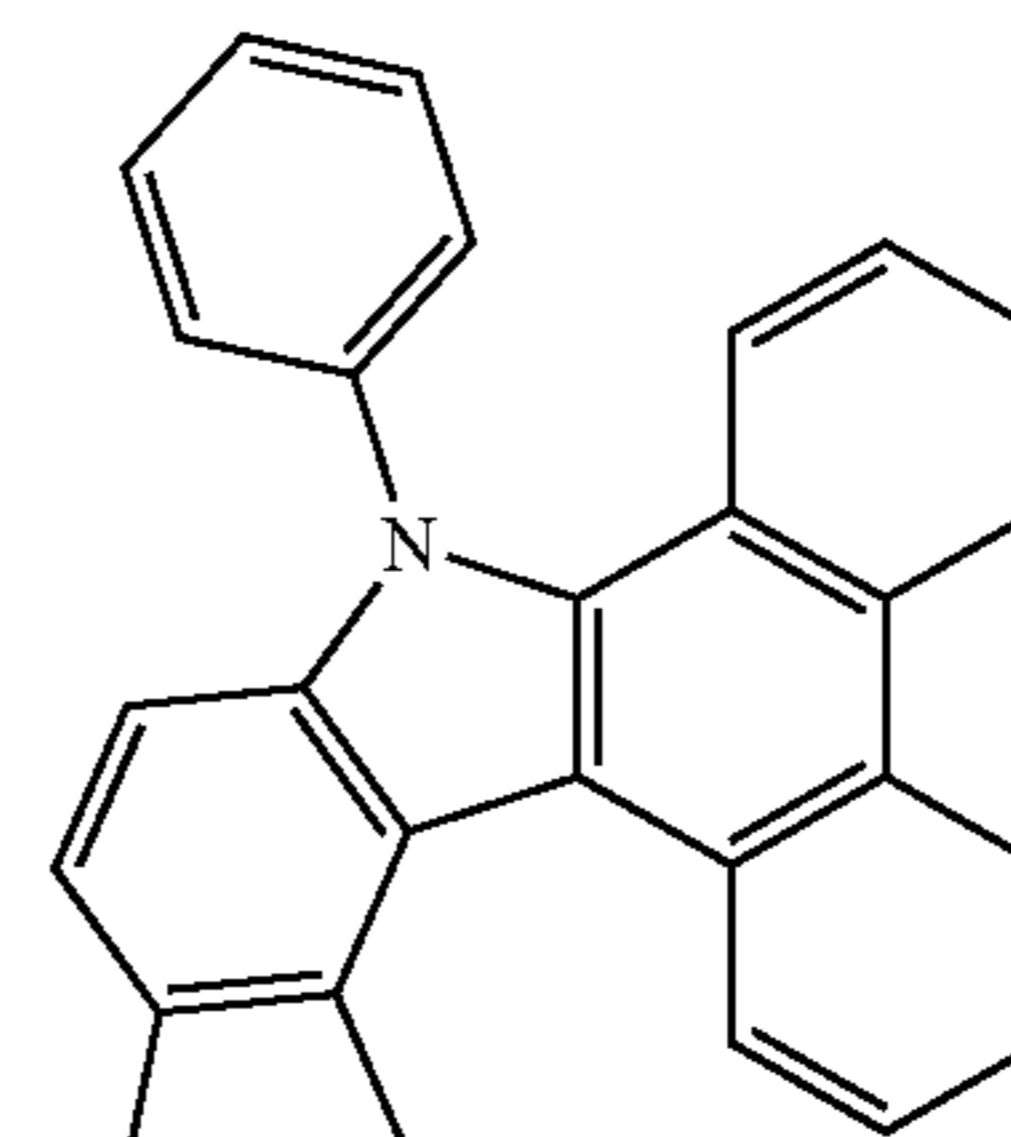


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Sub 3(50)

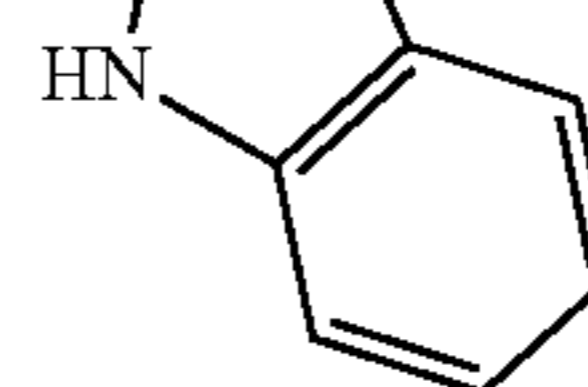
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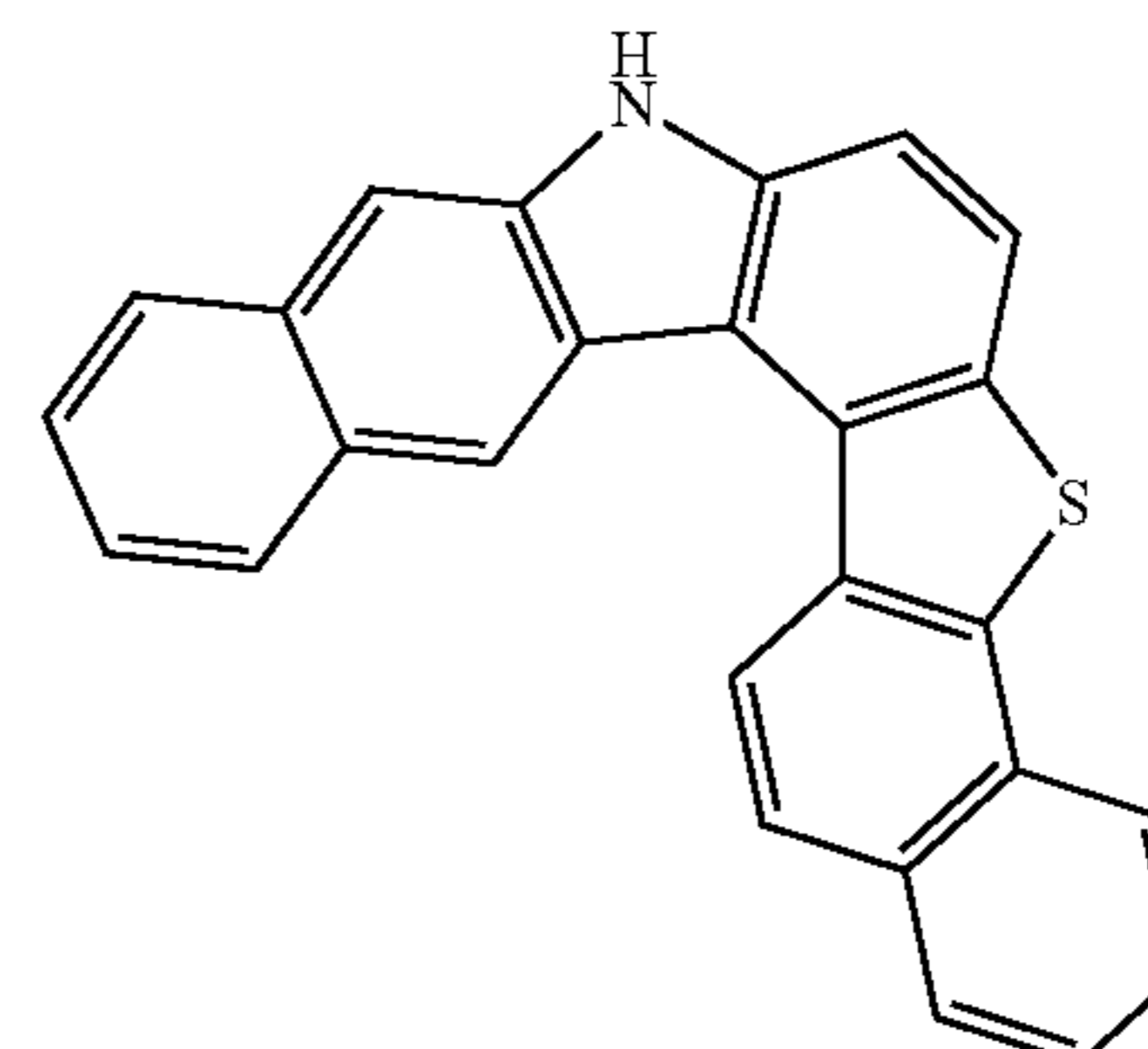
Sub 3(51)

40



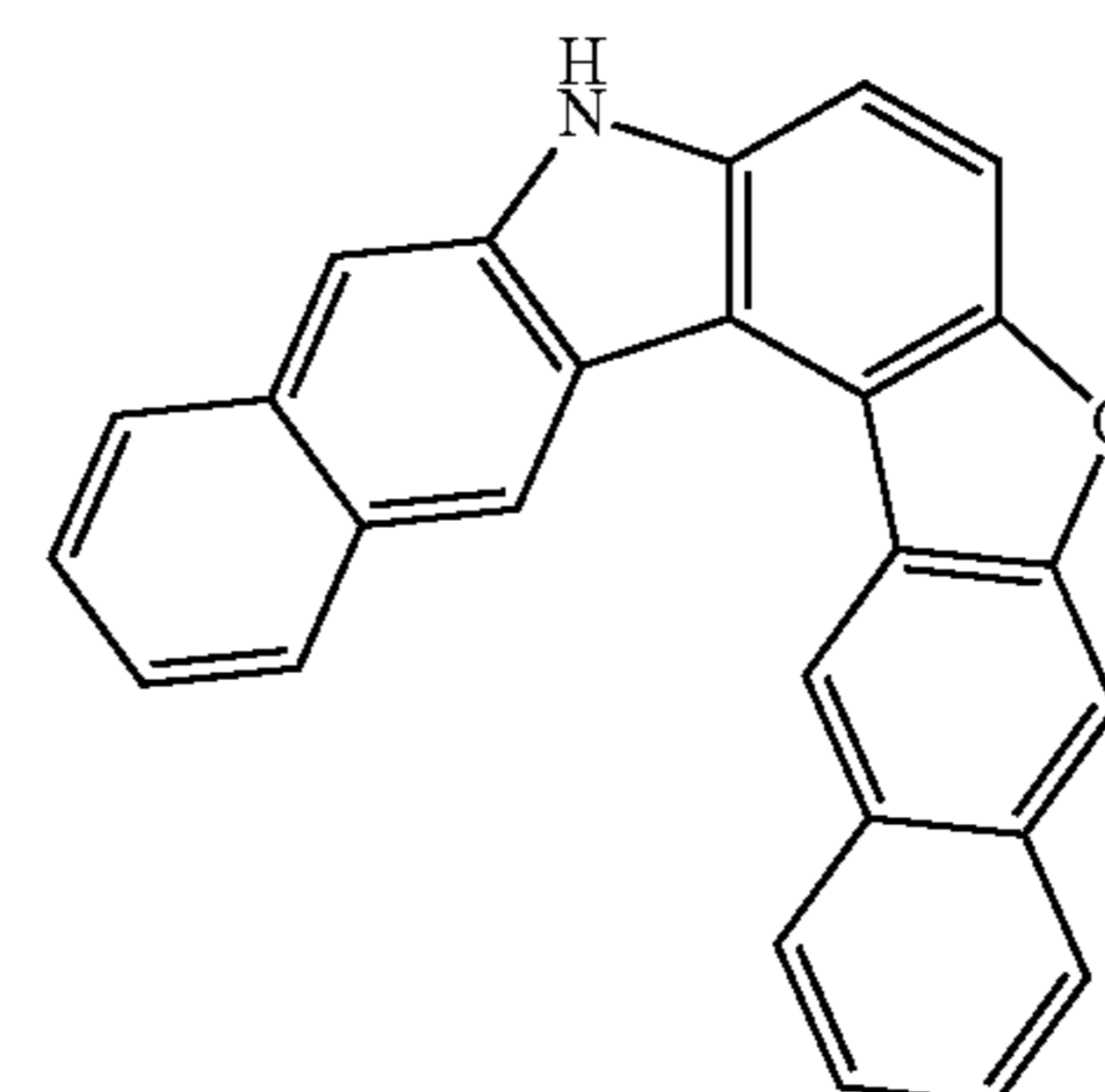
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Sub 3(52)

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Sub 3(53)

Sub 3(54)

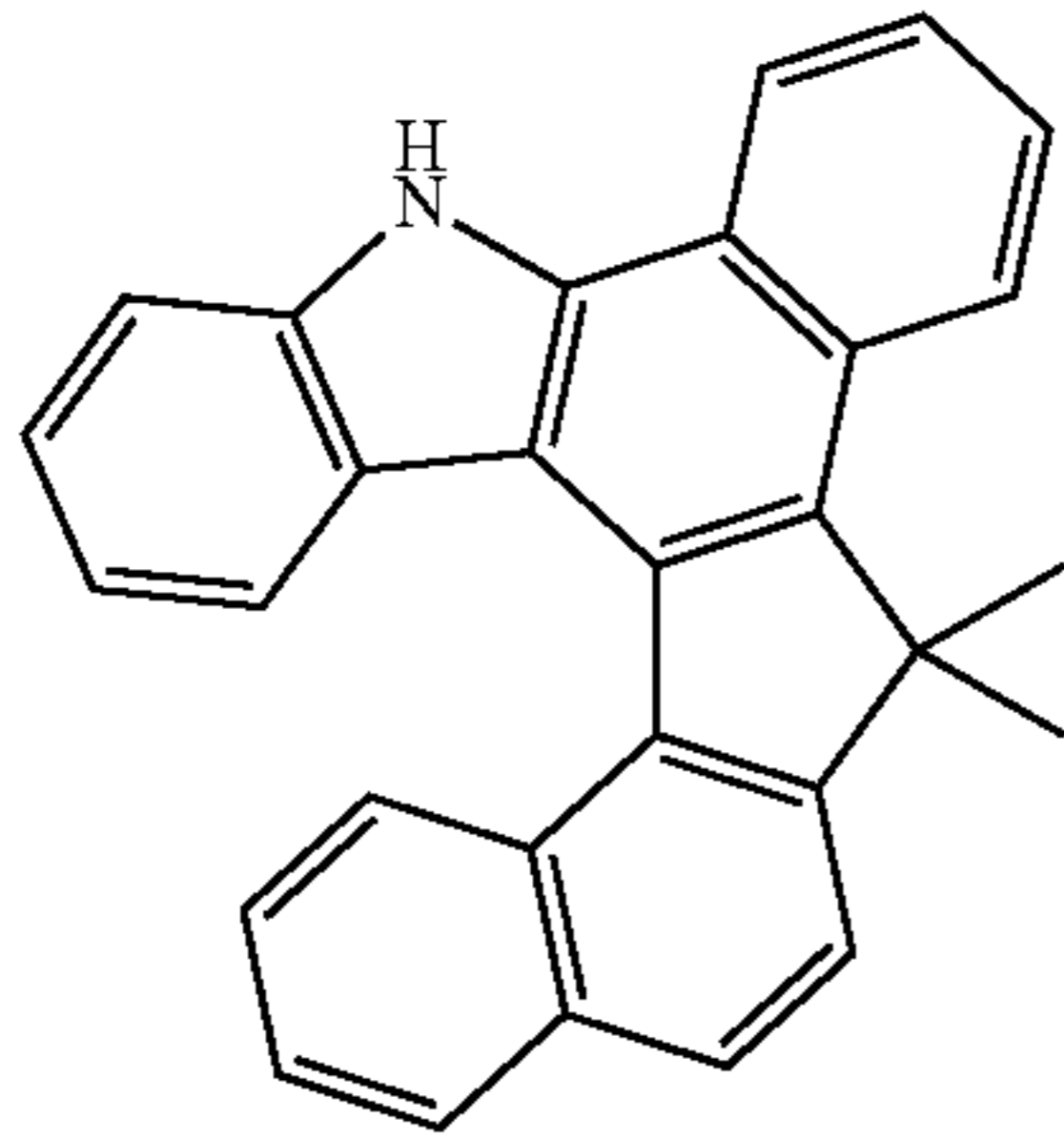
Sub 3(55)

Sub 3(56)

Sub 3(57)

**135**

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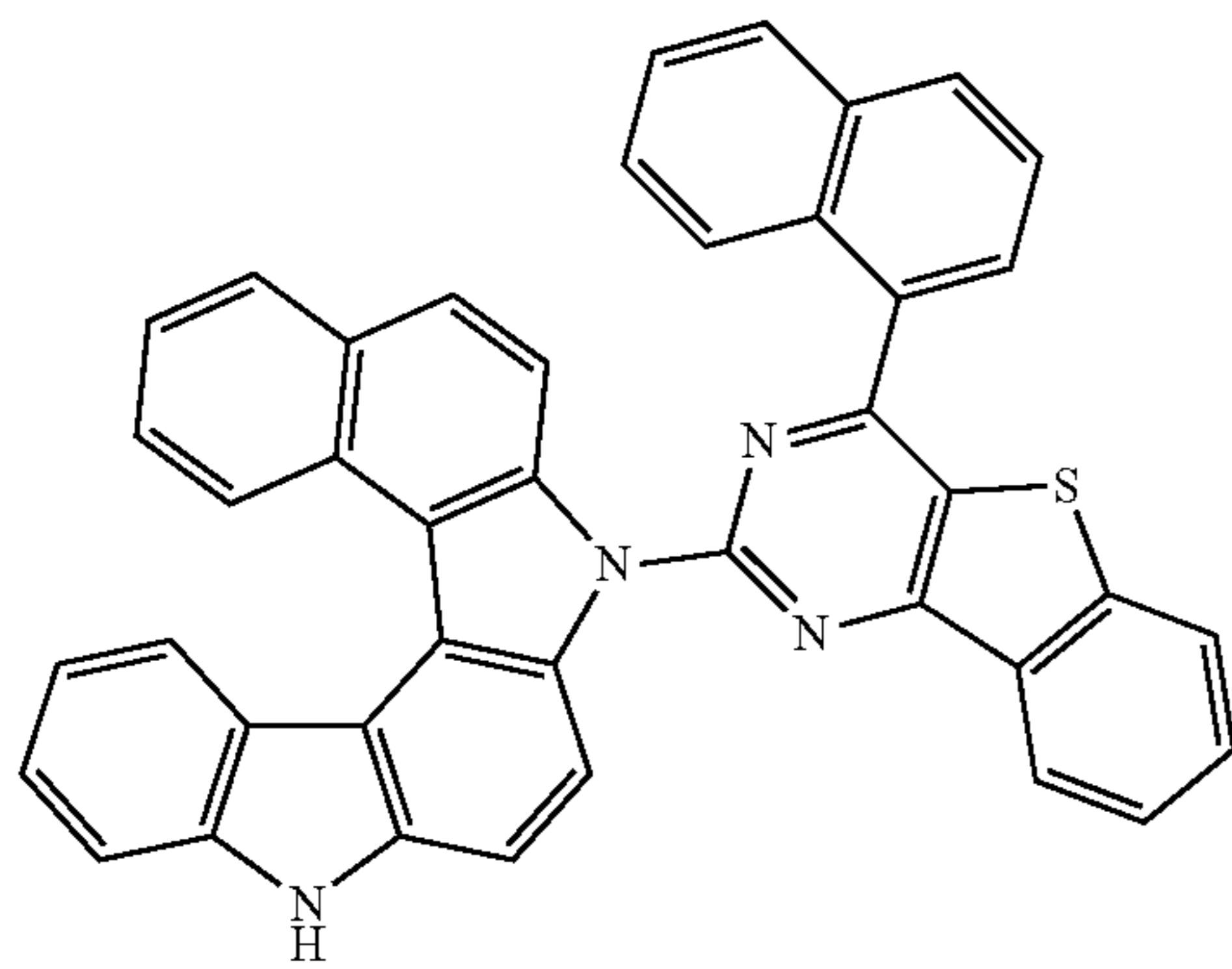
Sub 3(58)

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Sub 3(59)



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Sub 3(60)

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Sub 3(61)

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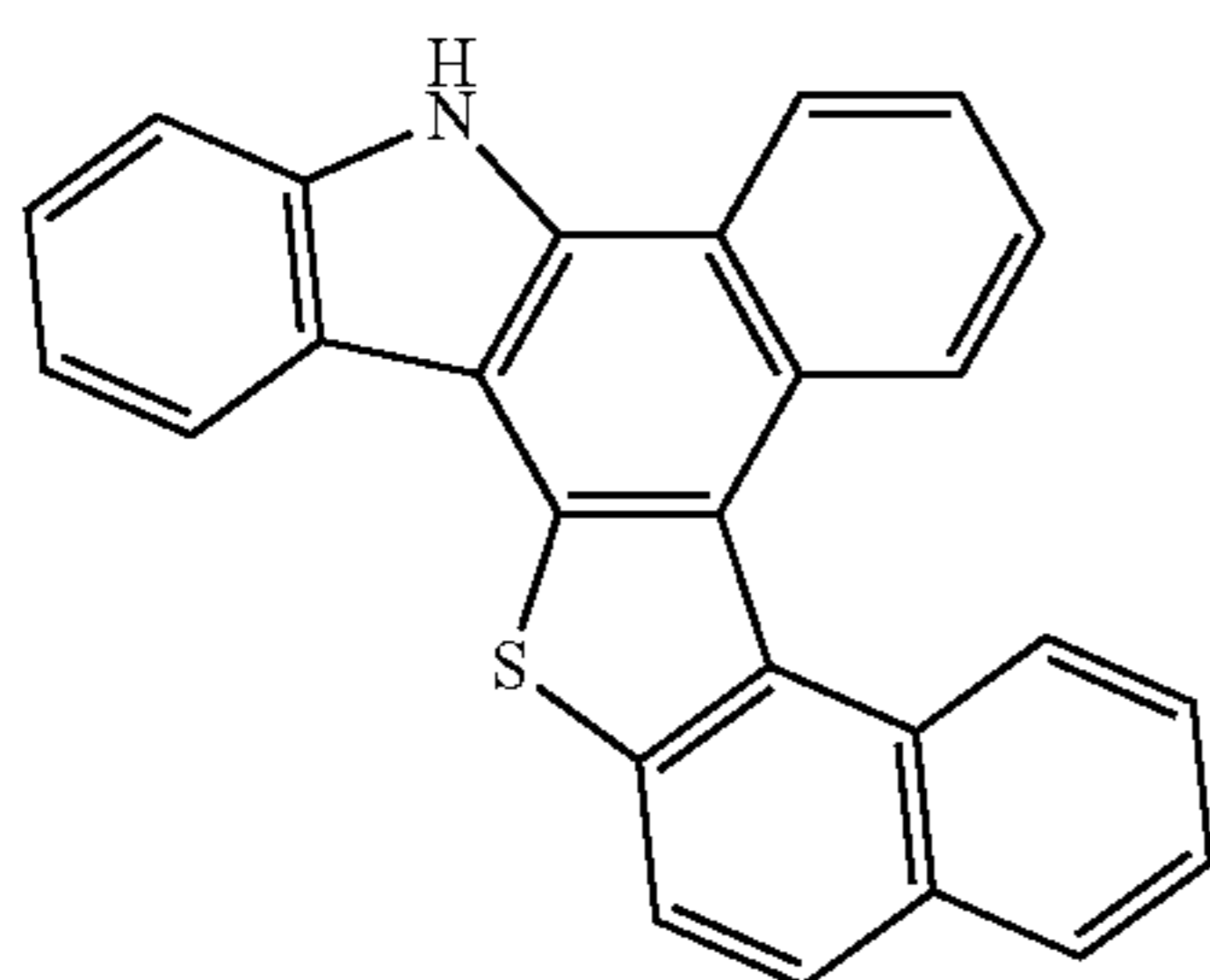
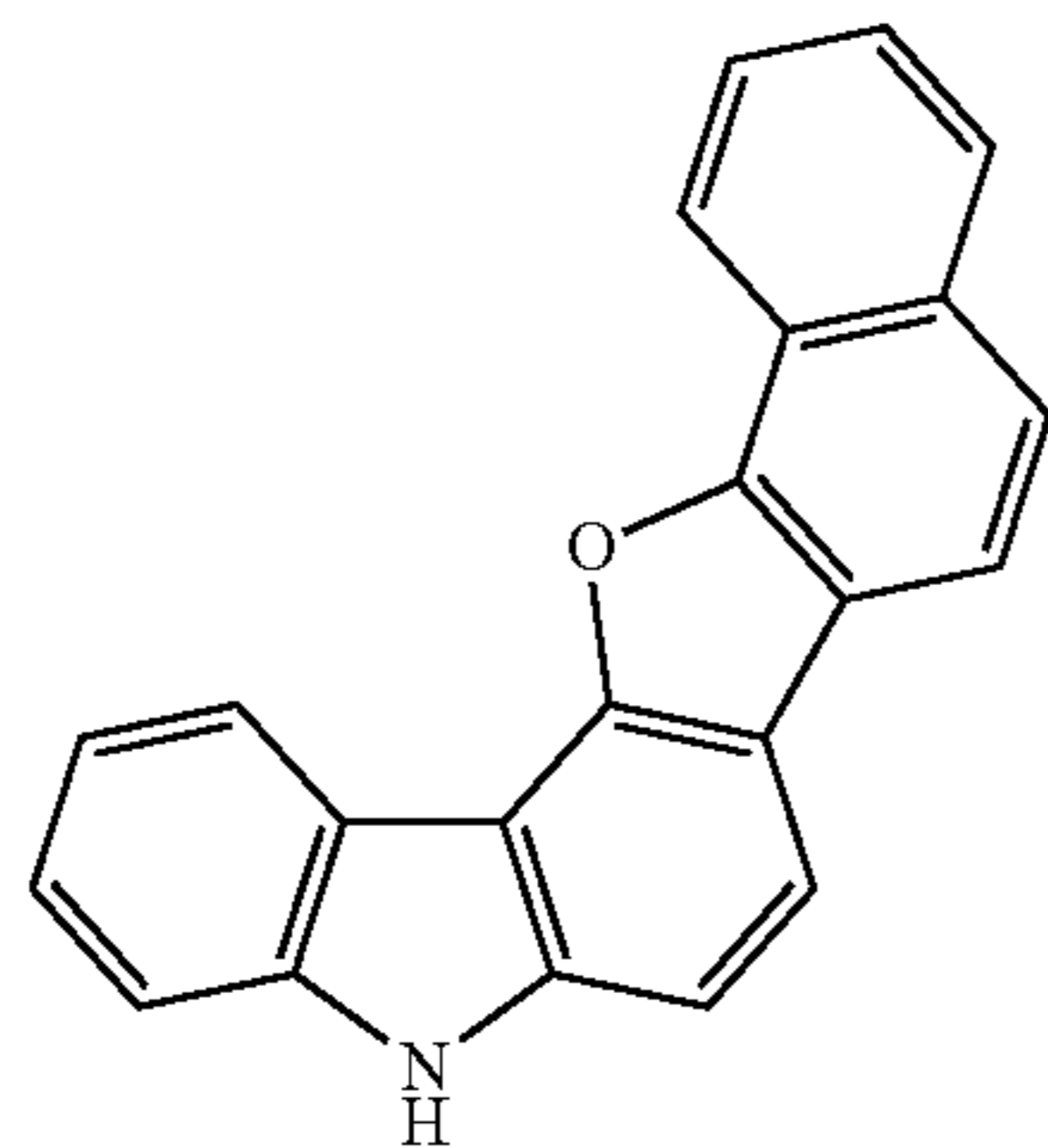
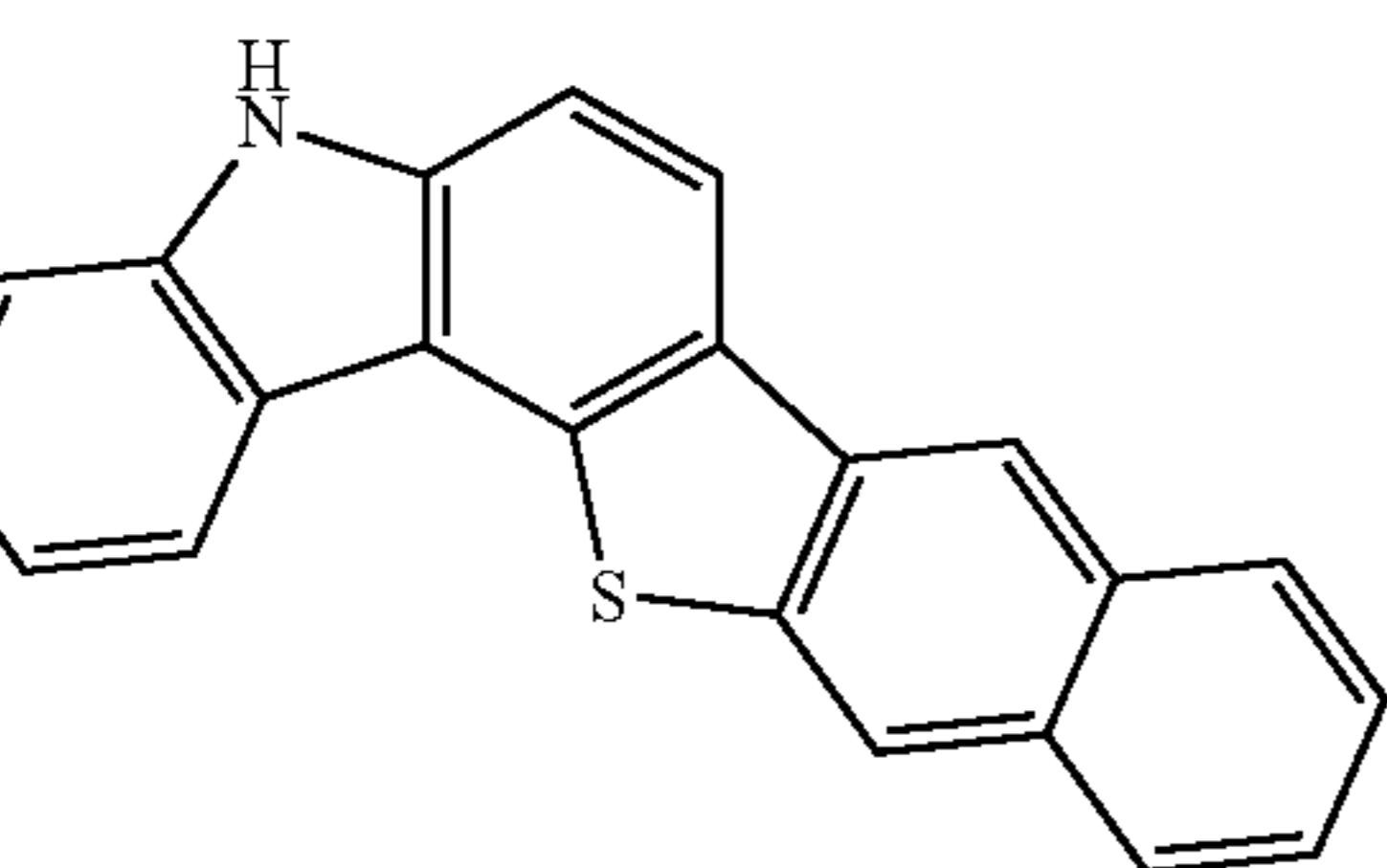
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Sub 3(62)

55

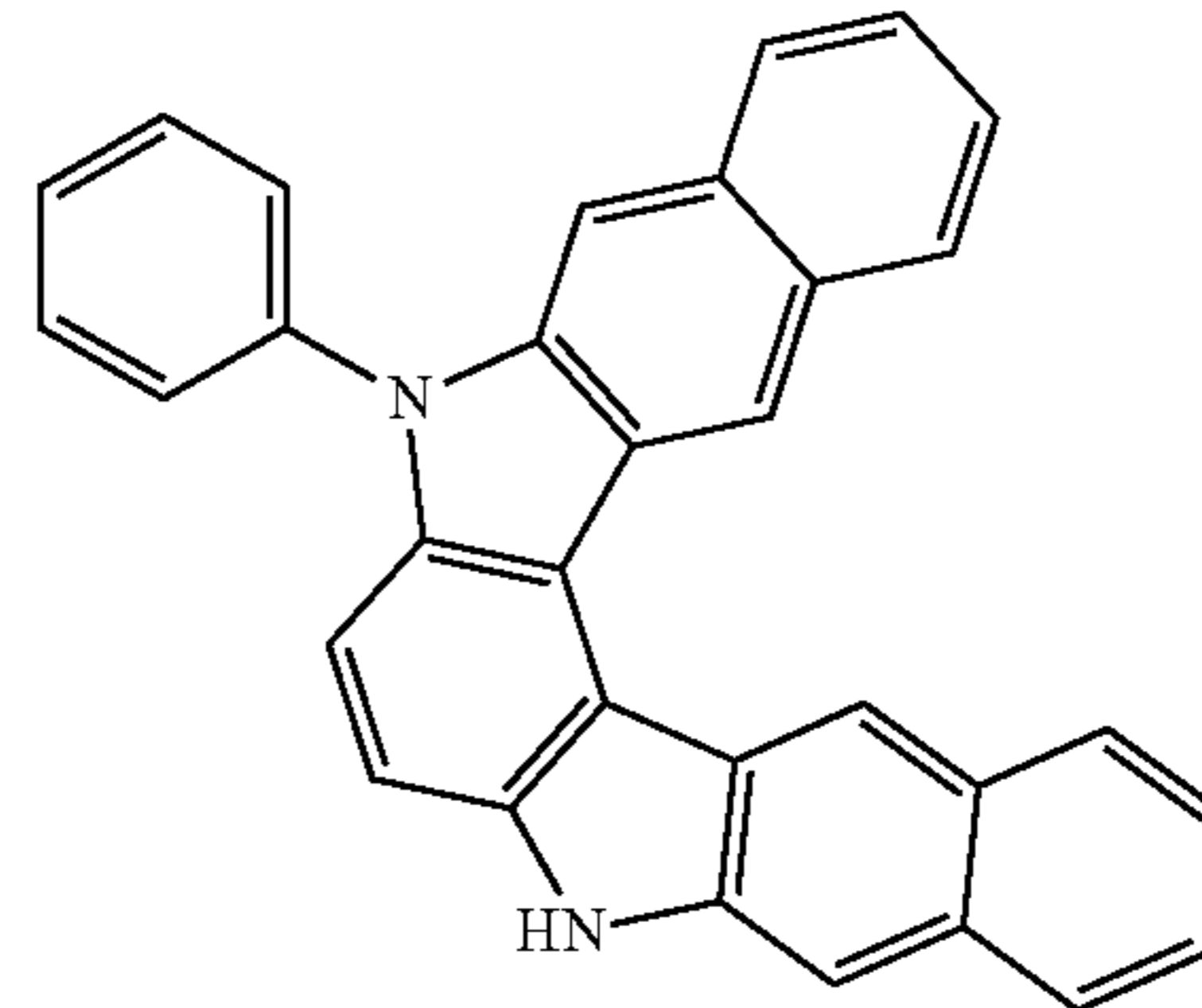
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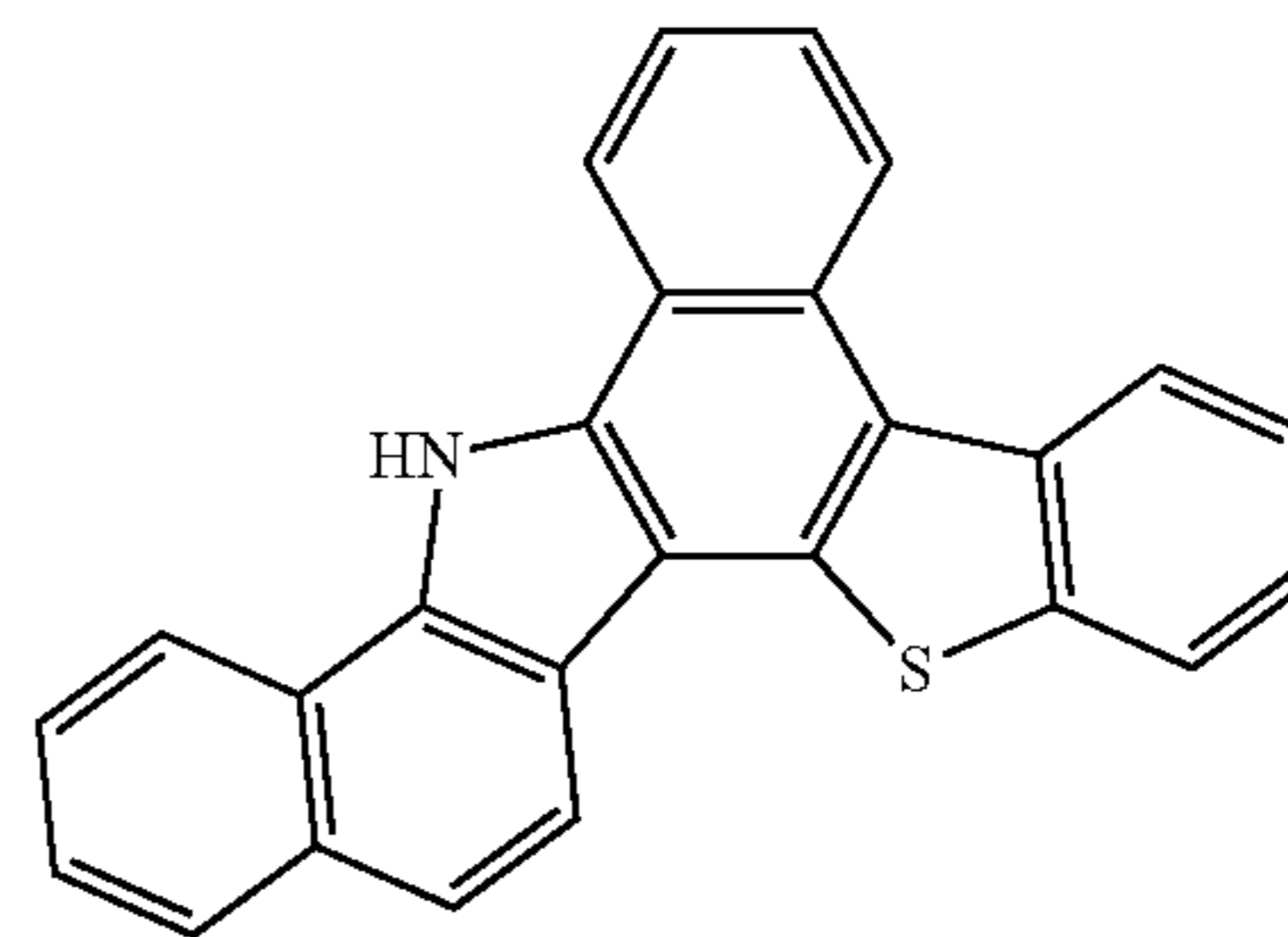


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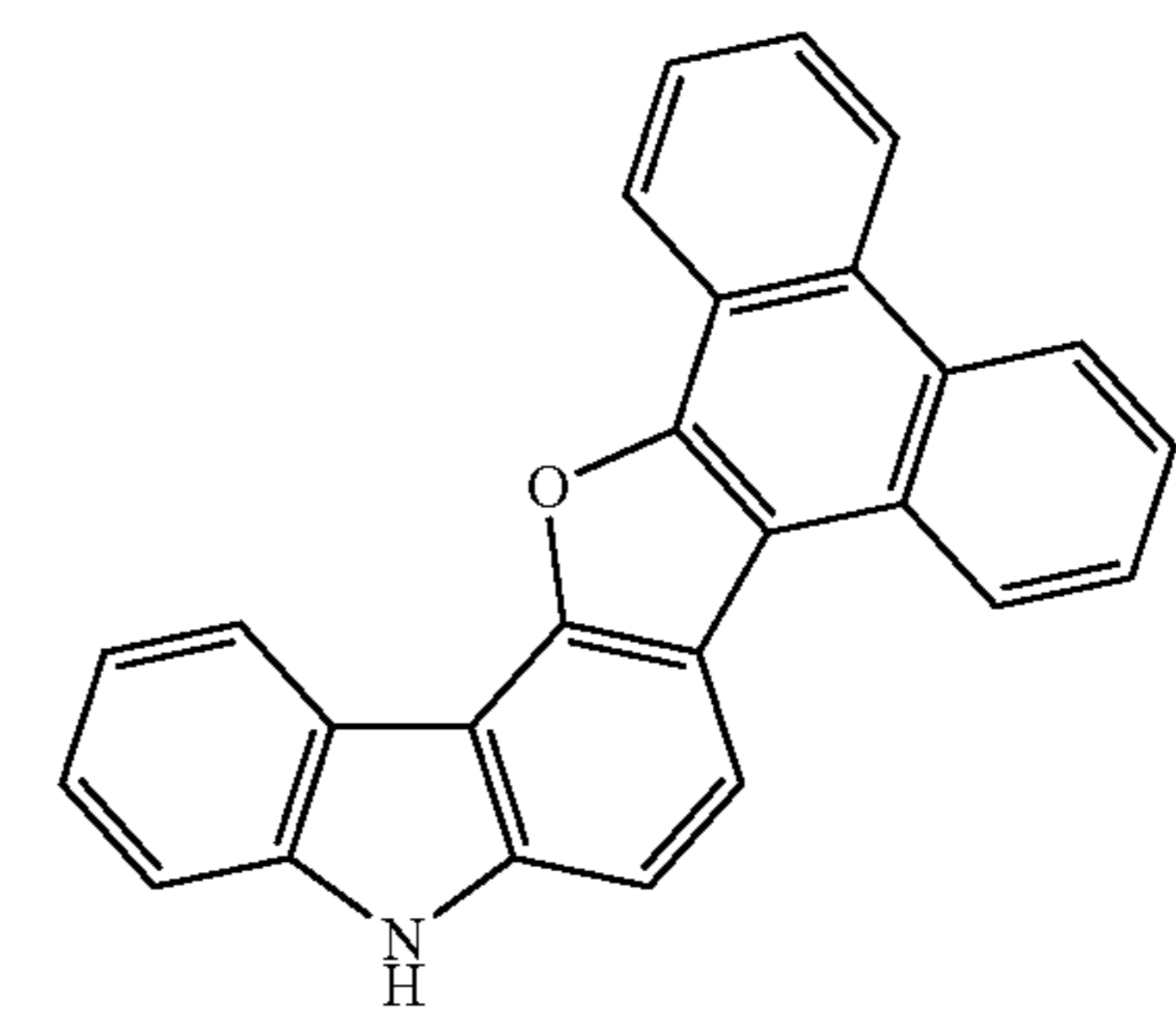
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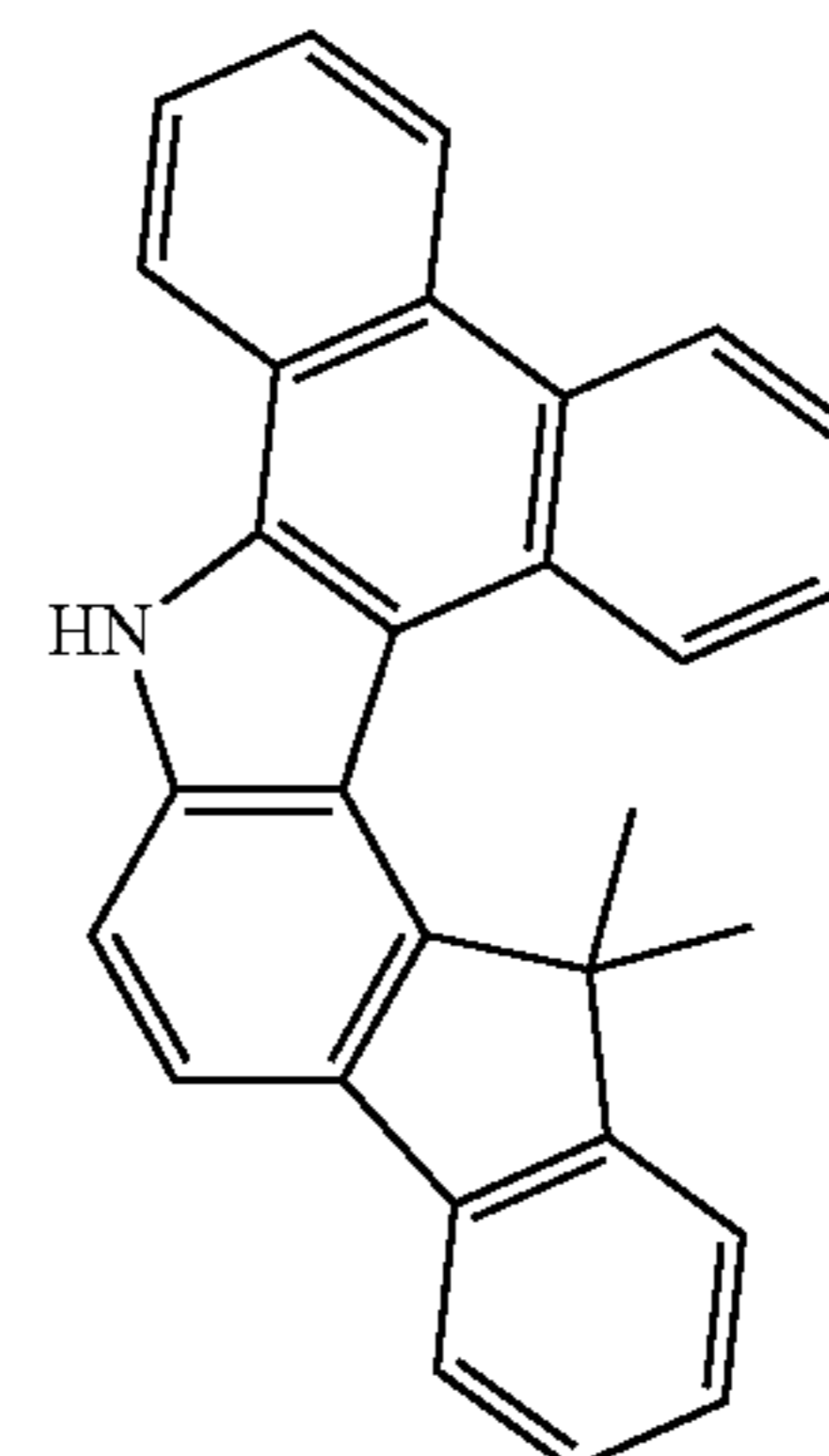
Sub 3(63)



Sub 3(64)



Sub 3(65)



Sub 3(66)

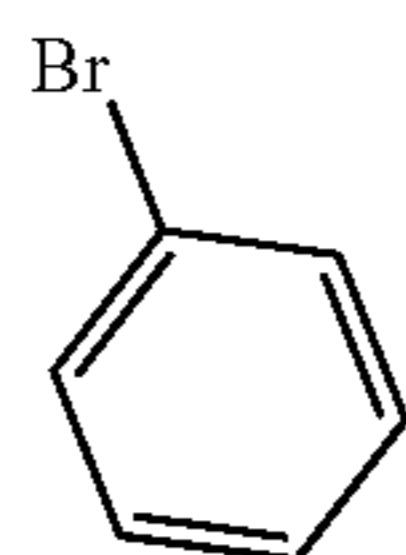
TABLE 3

compound	FD-MS	compound	FD-MS
Sub 3(1)	m/z = 323.08(C <sub>22</sub> H <sub>13</sub> NS = 323.41)	Sub 3(2)	m/z = 323.08(C <sub>22</sub> H <sub>13</sub> NS = 323.41)
Sub 3(3)	m/z = 307.10(C <sub>22</sub> H <sub>13</sub> NO = 307.34)	Sub 3(4)	m/z = 307.10(C <sub>22</sub> H <sub>13</sub> NO = 307.34)
Sub 3(5)	m/z = 333.15(C <sub>25</sub> H <sub>19</sub> N = 333.43)	Sub 3(6)	m/z = 382.15(C <sub>28</sub> H <sub>18</sub> N <sub>2</sub> = 382.46)
Sub 3(7)	m/z = 382.15(C <sub>28</sub> H <sub>18</sub> N <sub>2</sub> = 382.47)	Sub 3(8)	m/z = 323.08(C <sub>22</sub> H <sub>13</sub> NS = 323.41)
Sub 3(9)	m/z = 307.10(C <sub>22</sub> H <sub>13</sub> NO = 307.35)	Sub 3(10)	m/z = 383.17(C <sub>29</sub> H <sub>21</sub> N = 383.49)
Sub 3(11)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)	Sub 3(12)	m/z = 323.08(C <sub>22</sub> H <sub>13</sub> NS = 323.41)
Sub 3(13)	m/z = 357.12(C <sub>26</sub> H <sub>15</sub> NO = 357.41)	Sub 3(14)	m/z = 333.15(C <sub>25</sub> H <sub>19</sub> N = 333.43)
Sub 3(15)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)	Sub 3(16)	m/z = 357.12(C <sub>26</sub> H <sub>15</sub> NO = 357.41)
Sub 3(17)	m/z = 383.17(C <sub>29</sub> H <sub>21</sub> N = 383.49)	Sub 3(18)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)
Sub 3(19)	m/z = 407.13(C <sub>30</sub> H <sub>17</sub> NO = 407.47)	Sub 3(20)	m/z = 433.18(C <sub>33</sub> H <sub>23</sub> N = 433.55)
Sub 3(21)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)	Sub 3(22)	m/z = 357.12(C <sub>26</sub> H <sub>15</sub> NO = 357.41)
Sub 3(23)	m/z = 662.25(C <sub>48</sub> H <sub>30</sub> N <sub>4</sub> = 662.80)	Sub 3(24)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)
Sub 3(25)	m/z = 357.12(C <sub>26</sub> H <sub>15</sub> NO = 357.41)	Sub 3(26)	m/z = 383.17(C <sub>29</sub> H <sub>21</sub> N = 383.49)
Sub 3(27)	m/z = 432.16(C <sub>32</sub> H <sub>20</sub> N <sub>2</sub> = 432.53)	Sub 3(28)	m/z = 323.08(C <sub>22</sub> H <sub>13</sub> NS = 323.41)
Sub 3(29)	m/z = 307.10(C <sub>22</sub> H <sub>13</sub> NO = 307.35)	Sub 3(30)	m/z = 455.17(C <sub>35</sub> H <sub>21</sub> N = 455.56)
Sub 3(31)	m/z = 432.16(C <sub>32</sub> H <sub>20</sub> N <sub>2</sub> = 432.53)	Sub 3(32)	m/z = 323.08(C <sub>22</sub> H <sub>13</sub> NS = 323.41)
Sub 3(33)	m/z = 307.10(C <sub>22</sub> H <sub>13</sub> NO = 307.35)	Sub 3(34)	m/z = 383.17(C <sub>29</sub> H <sub>21</sub> N = 383.49)
Sub 3(35)	m/z = 432.16(C <sub>32</sub> H <sub>20</sub> N <sub>2</sub> = 439.53)	Sub 3(36)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)
Sub 3(37)	m/z = 357.12(C <sub>26</sub> H <sub>15</sub> NO = 357.41)	Sub 3(38)	m/z = 383.17(C <sub>29</sub> H <sub>21</sub> N = 383.49)
Sub 3(39)	m/z = 432.16(C <sub>32</sub> H <sub>20</sub> N <sub>2</sub> = 432.53)	Sub 3(40)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)
Sub 3(41)	m/z = 357.12(C <sub>26</sub> H <sub>15</sub> NO = 357.41)	Sub 3(42)	m/z = 383.17(C <sub>29</sub> H <sub>21</sub> N = 383.49)
Sub 3(43)	m/z = 432.16(C <sub>32</sub> H <sub>20</sub> N <sub>2</sub> = 432.53)	Sub 3(44)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)
Sub 3(45)	m/z = 357.12(C <sub>26</sub> H <sub>15</sub> NO = 357.41)	Sub 3(46)	m/z = 505.18(C <sub>39</sub> H <sub>23</sub> N = 505.62)
Sub 3(47)	m/z = 382.15(C <sub>28</sub> H <sub>18</sub> N <sub>2</sub> = 382.47)	Sub 3(48)	m/z = 323.08(C <sub>22</sub> H <sub>13</sub> NS = 323.41)
Sub 3(49)	m/z = 307.10(C <sub>22</sub> H <sub>13</sub> NO = 307.35)	Sub 3(50)	m/z = 333.15(C <sub>25</sub> H <sub>19</sub> N = 333.43)
Sub 3(51)	m/z = 432.16(C <sub>32</sub> H <sub>20</sub> N <sub>2</sub> = 432.53)	Sub 3(52)	m/z = 323.08(C <sub>22</sub> H <sub>13</sub> NS = 323.41)
Sub 3(53)	m/z = 307.10(C <sub>22</sub> H <sub>13</sub> NO = 307.35)	Sub 3(54)	m/z = 457.18(C <sub>35</sub> H <sub>23</sub> N = 457.58)
Sub 3(55)	m/z = 432.16(C <sub>32</sub> H <sub>20</sub> N <sub>2</sub> = 432.53)	Sub 3(56)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)
Sub 3(57)	m/z = 357.12(C <sub>26</sub> H <sub>15</sub> NO = 357.41)	Sub 3(58)	m/z = 383.17(C <sub>29</sub> H <sub>21</sub> N = 383.49)
Sub 3(59)	m/z = 616.17(C <sub>42</sub> H <sub>24</sub> N <sub>4</sub> S = 616.74)	Sub 3(60)	m/z = 323.08(C <sub>22</sub> H <sub>13</sub> NS = 323.41)
Sub 3(61)	m/z = 307.10(C <sub>22</sub> H <sub>13</sub> NO = 307.35)	Sub 3(62)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)
Sub 3(63)	m/z = 432.16(C <sub>32</sub> H <sub>20</sub> N <sub>2</sub> = 432.53)	Sub 3(64)	m/z = 373.09(C <sub>26</sub> H <sub>15</sub> NS = 373.47)
Sub 3(65)	m/z = 357.12(C <sub>26</sub> H <sub>15</sub> NO = 357.41)	Sub 3(66)	m/z = 383.17(C <sub>29</sub> H <sub>21</sub> N = 383.49)

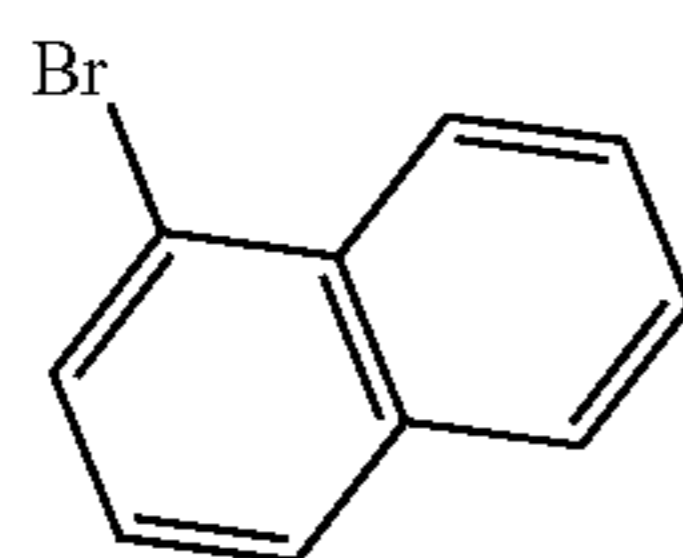
## Examples of Sub 4

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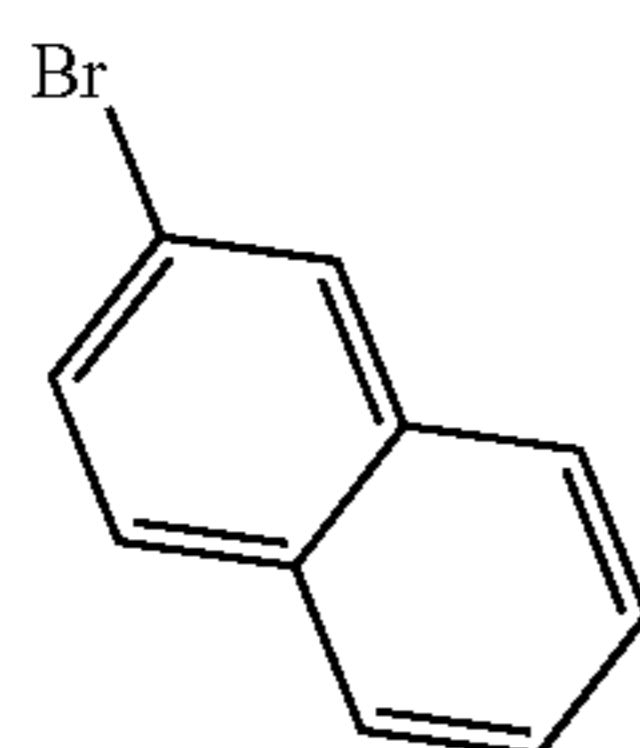
Examples of Sub 4 include, but are not limited to, the followings.



Sub 4-1



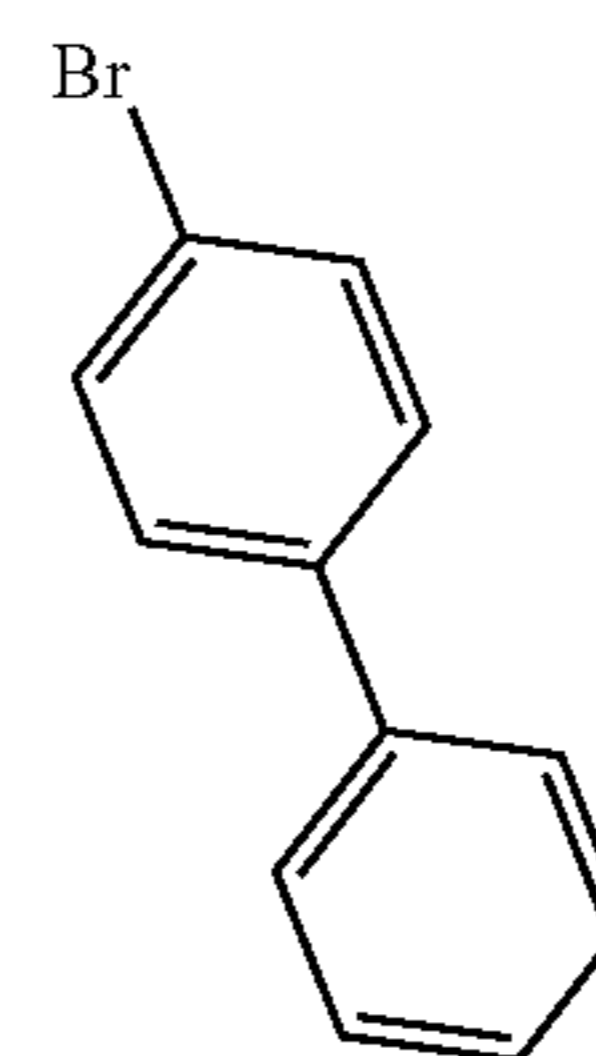
Sub 4-2



Sub 4-3

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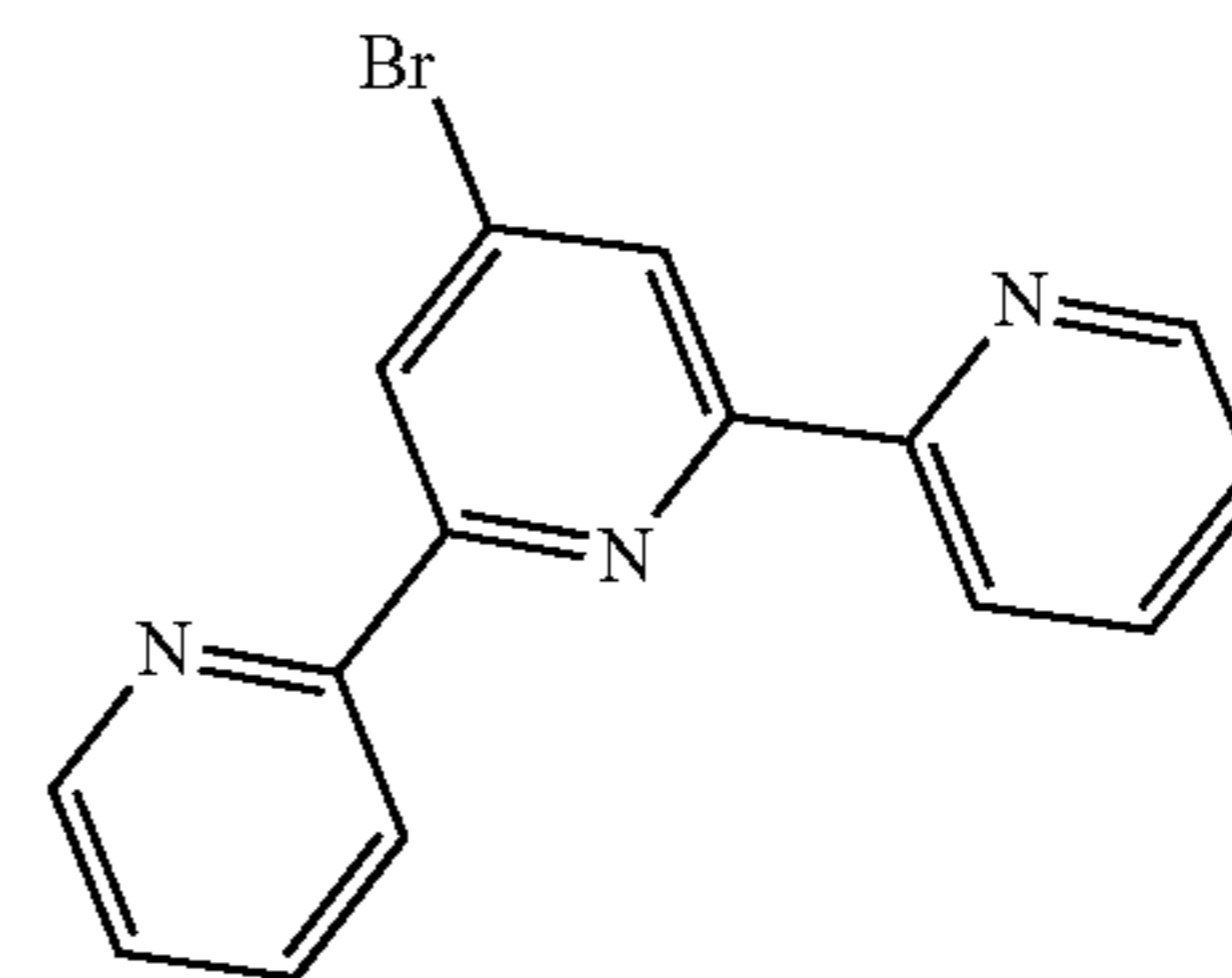
Sub 4-4



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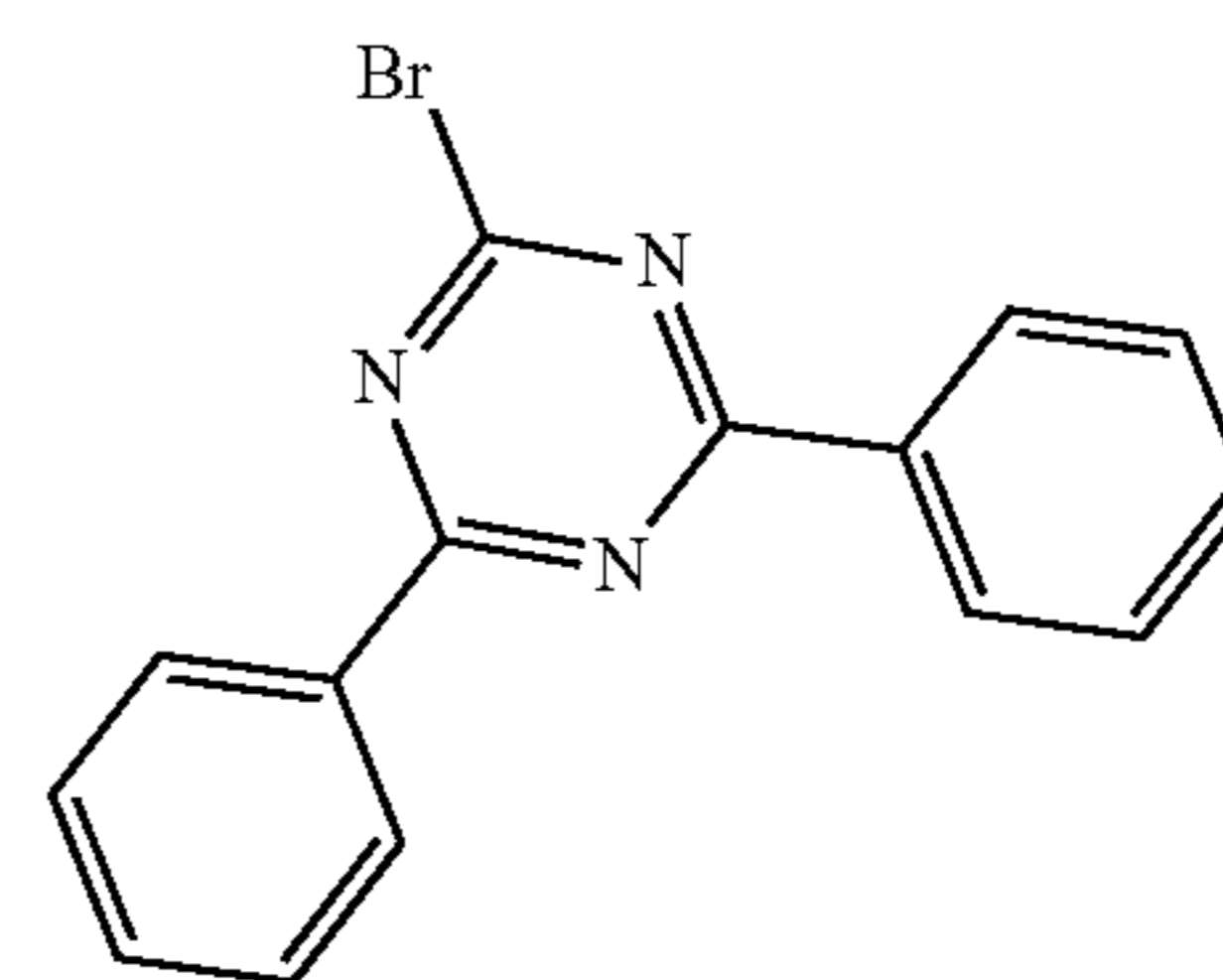
Sub 4-5



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Sub 4-6



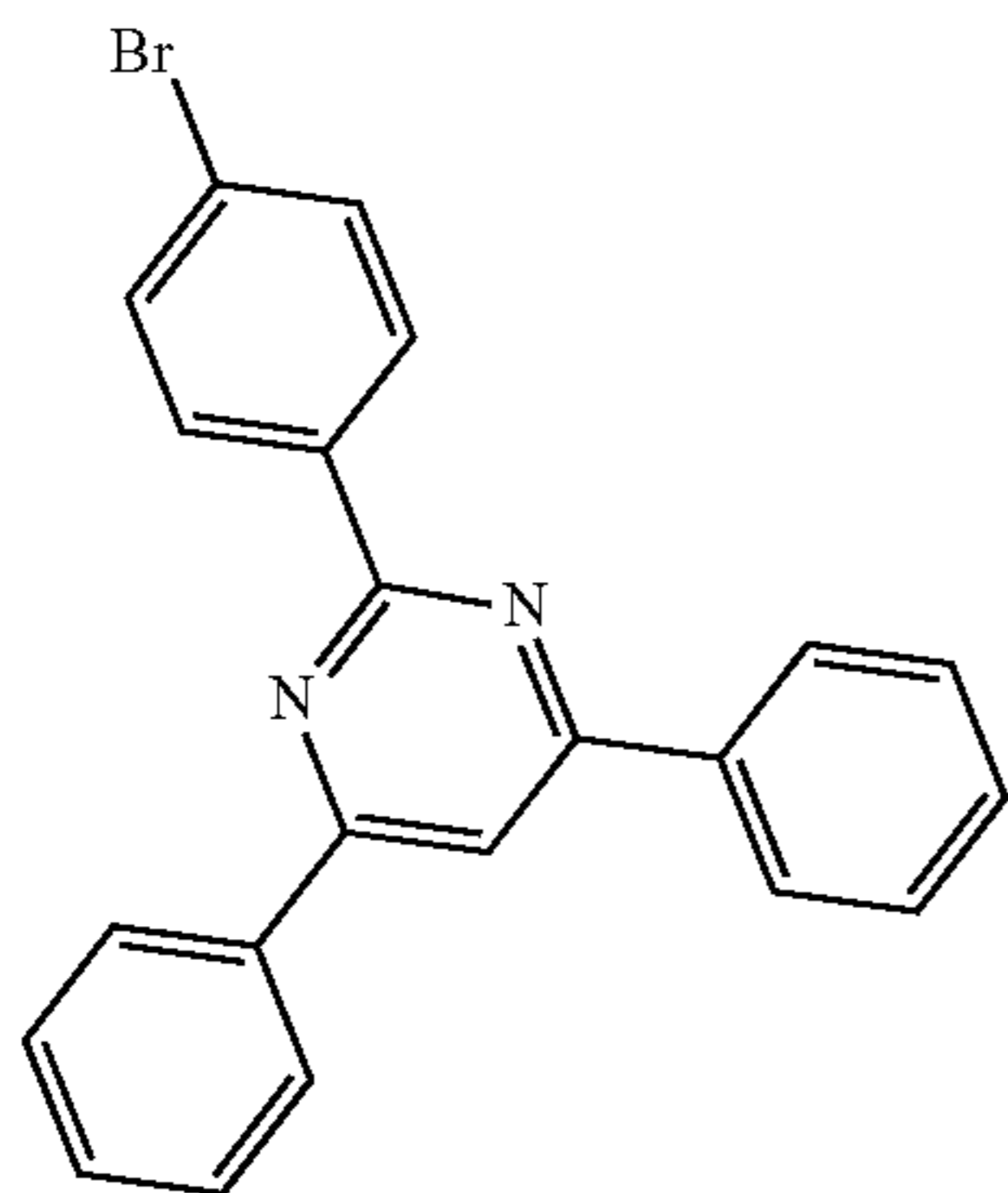
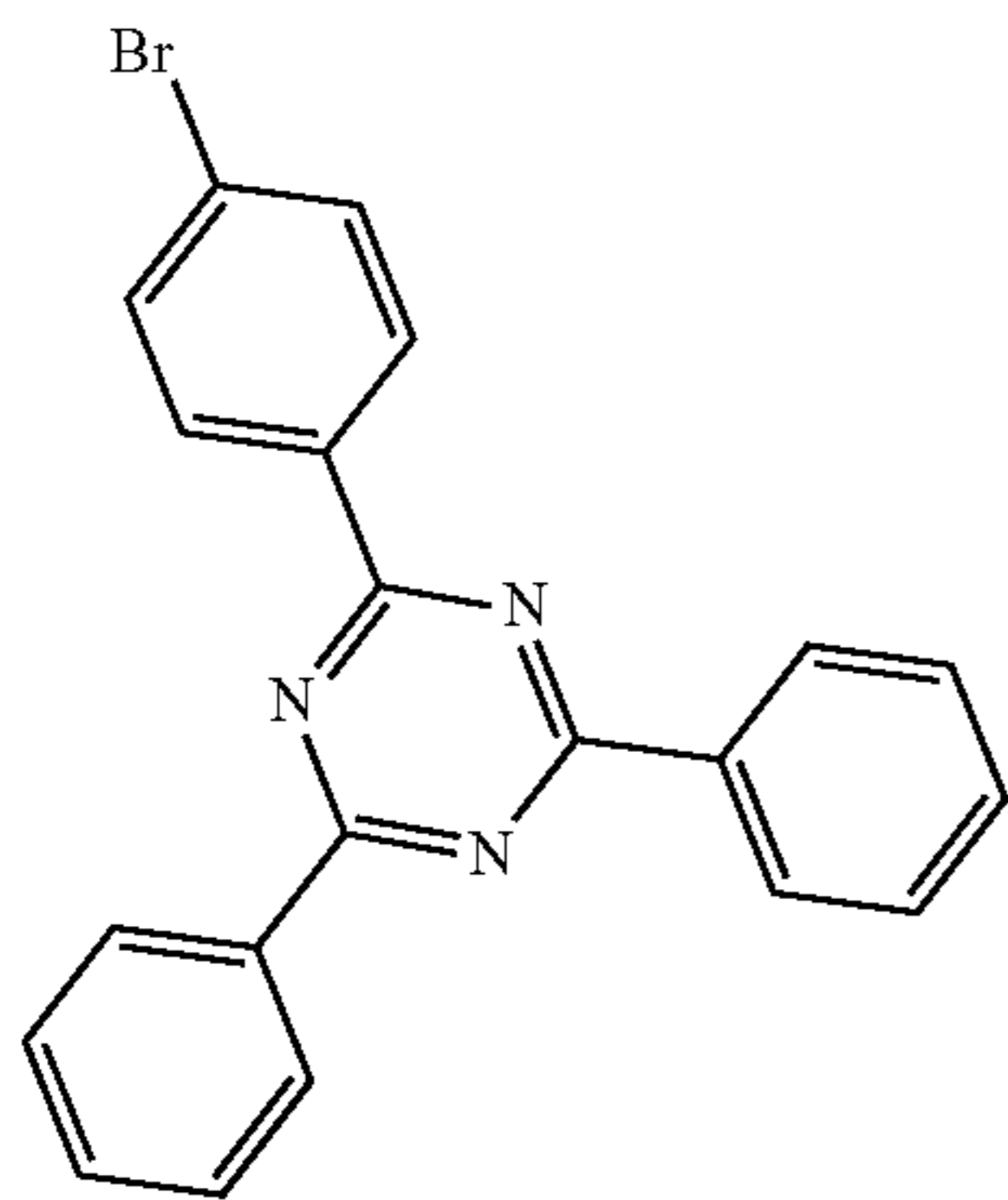
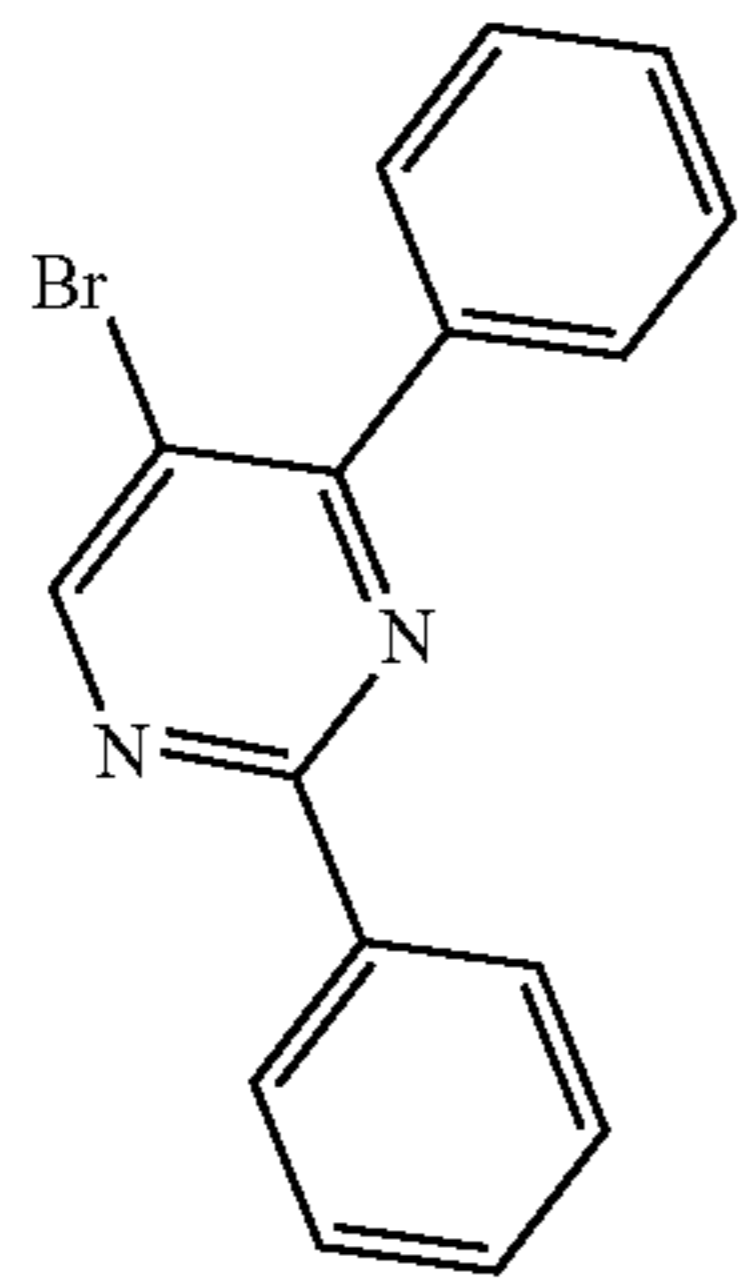
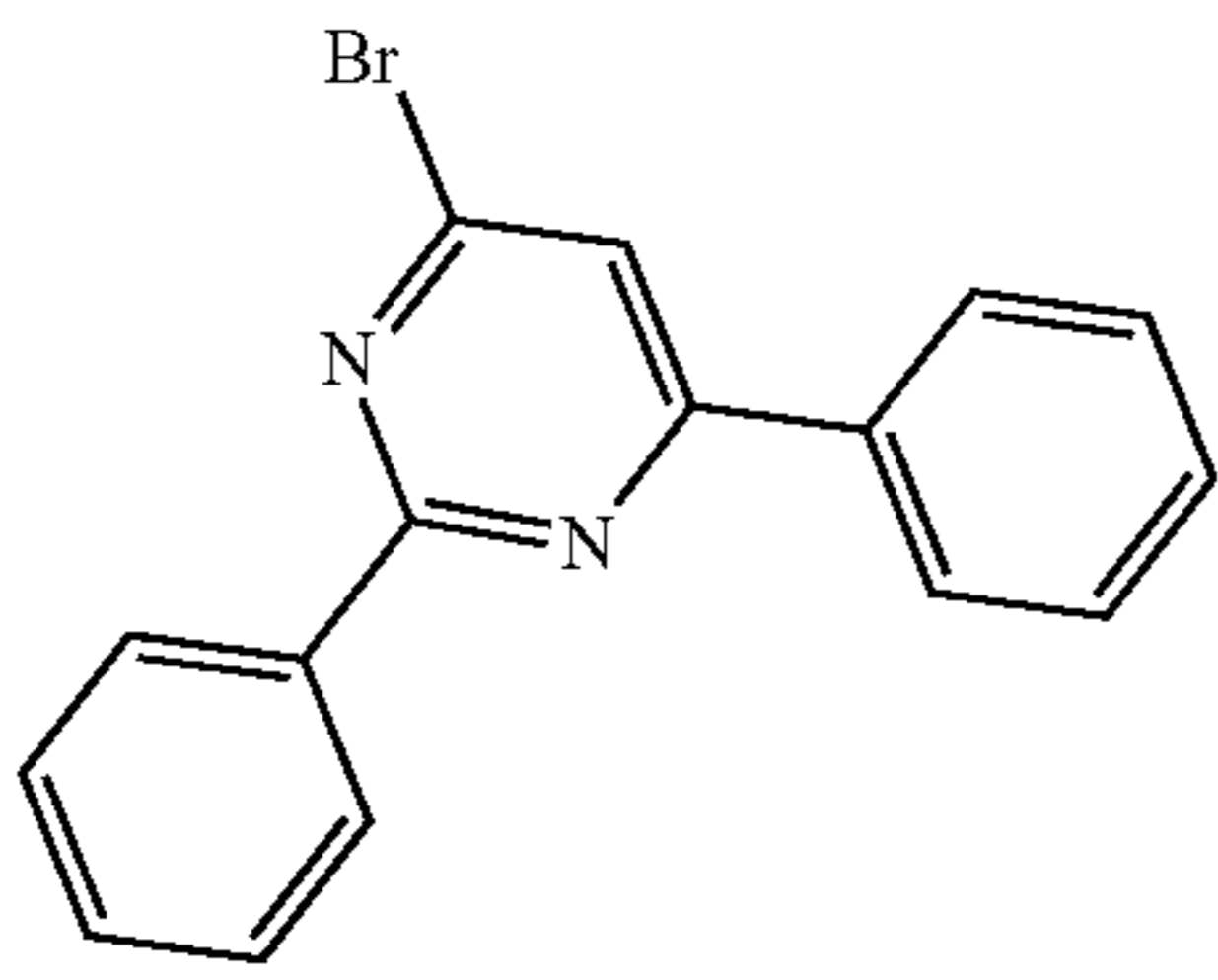
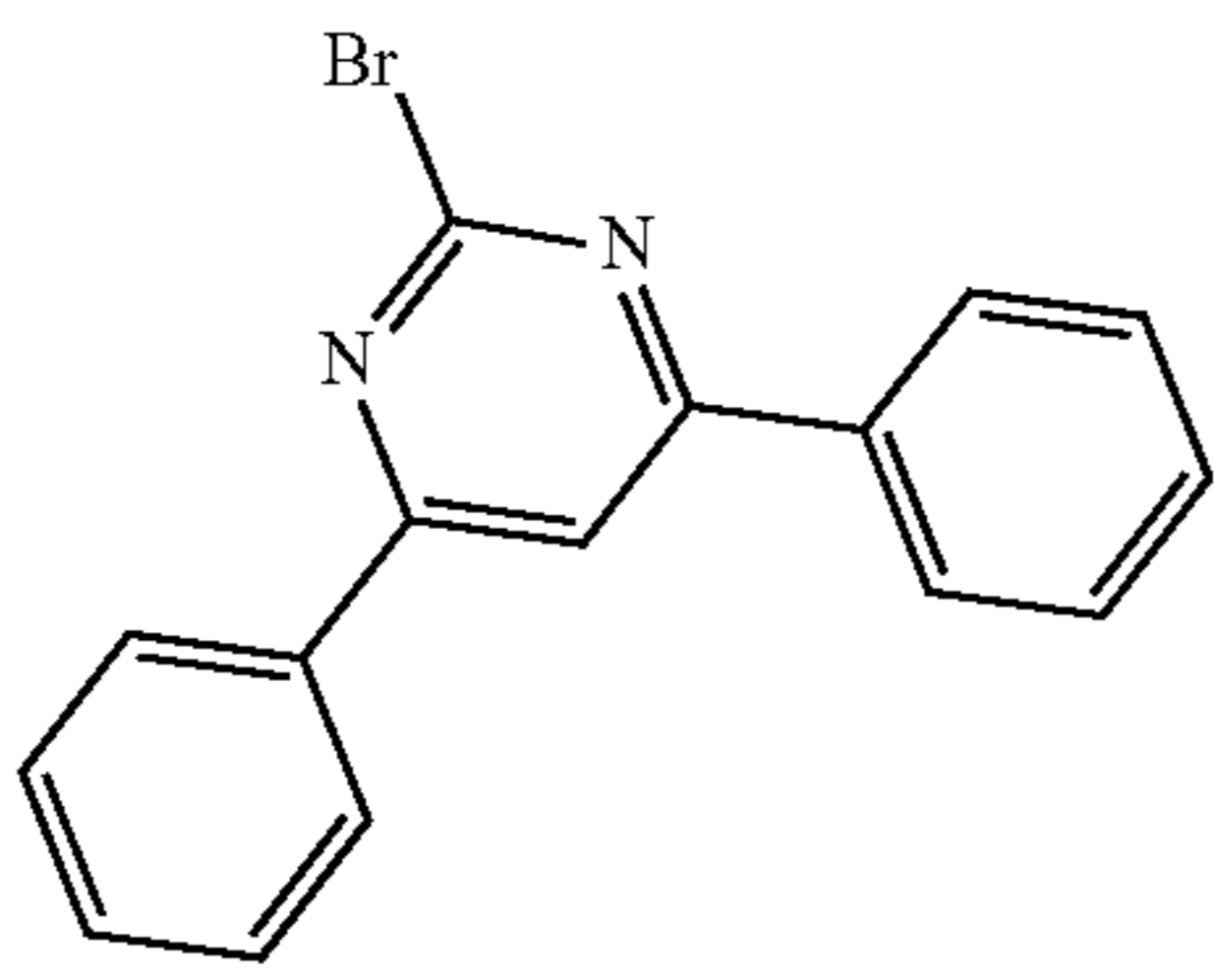
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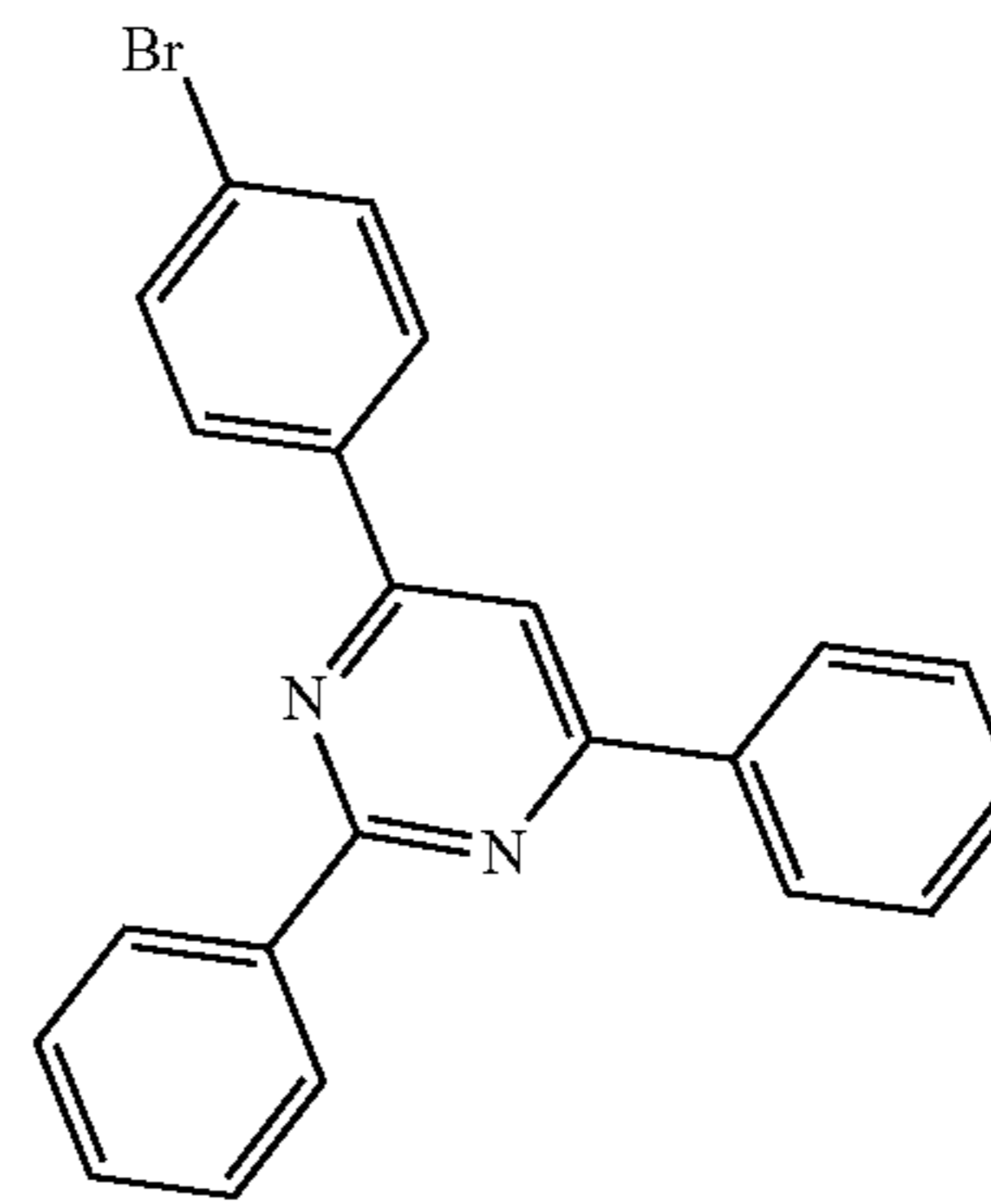


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Sub 4-7

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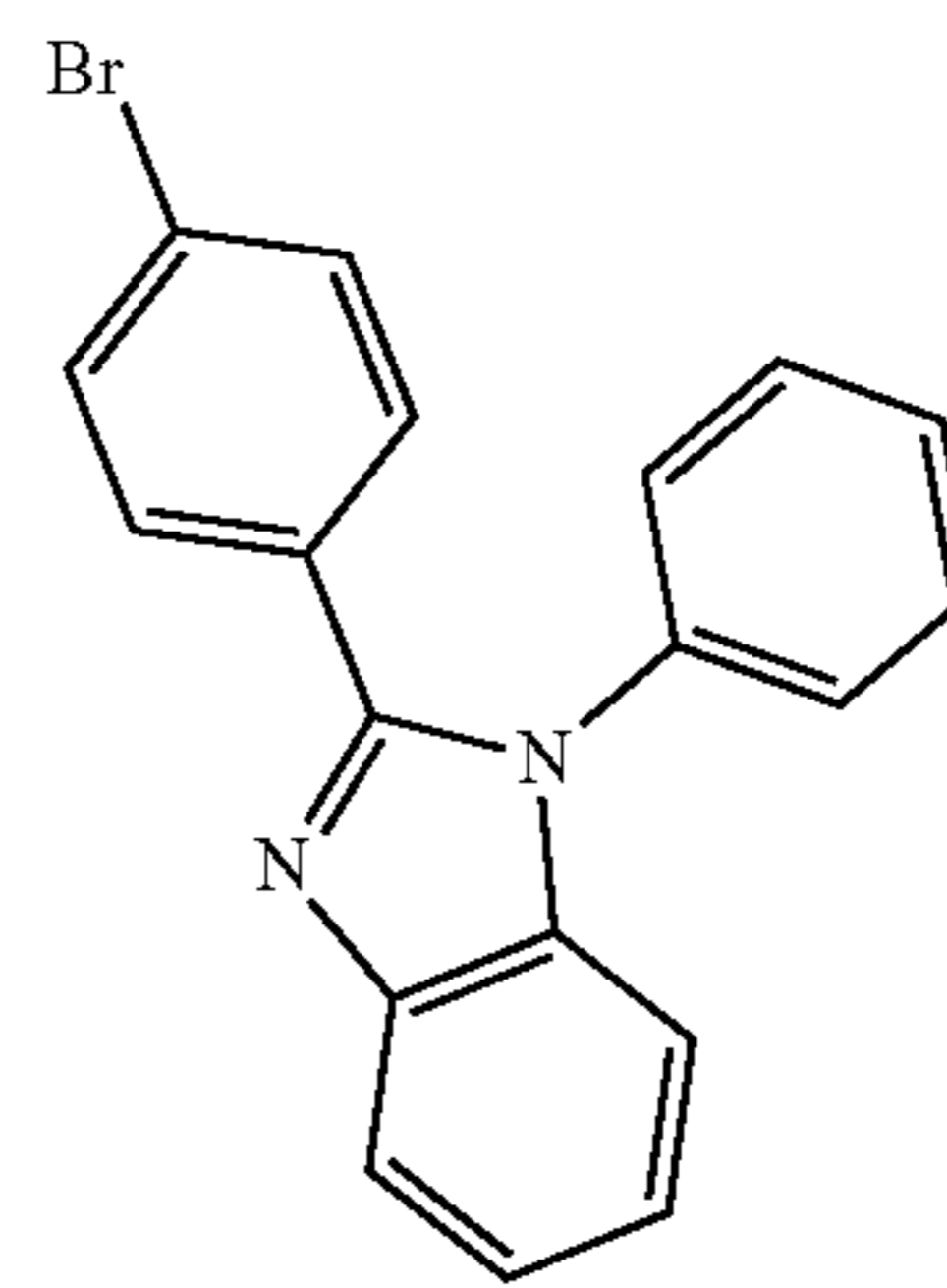


Sub 4-8

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Sub 4-9

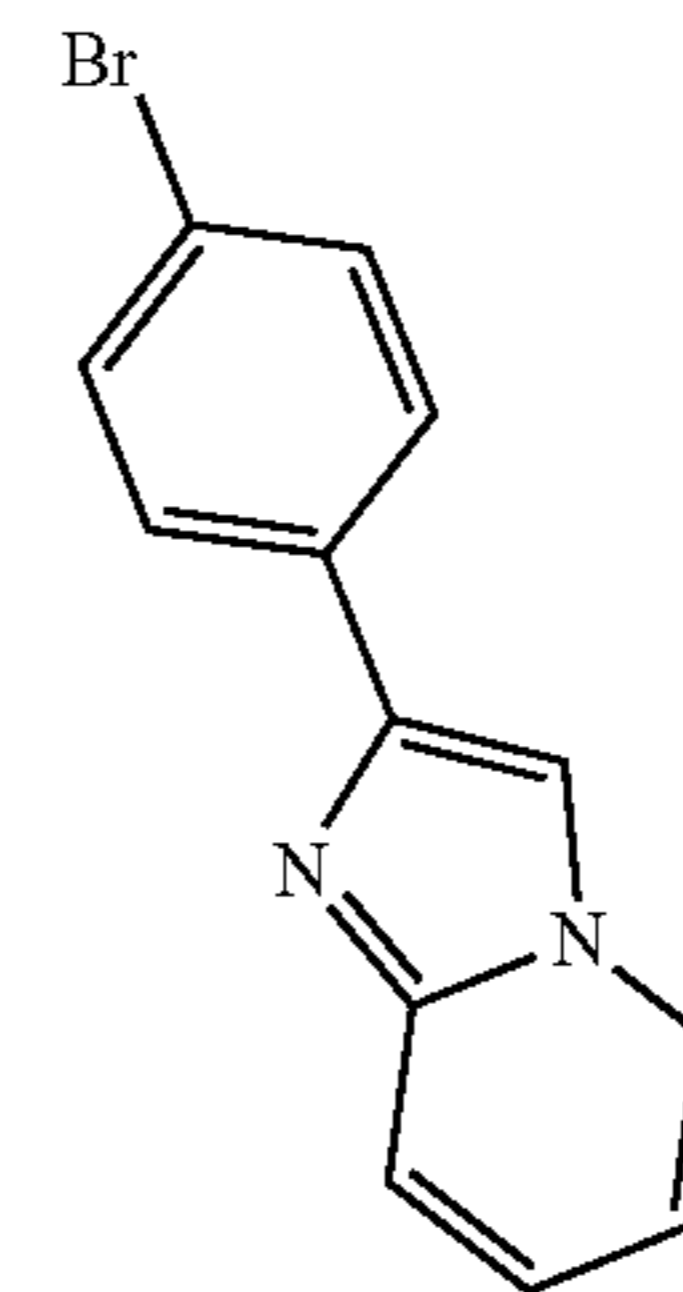
25



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Sub 4-10

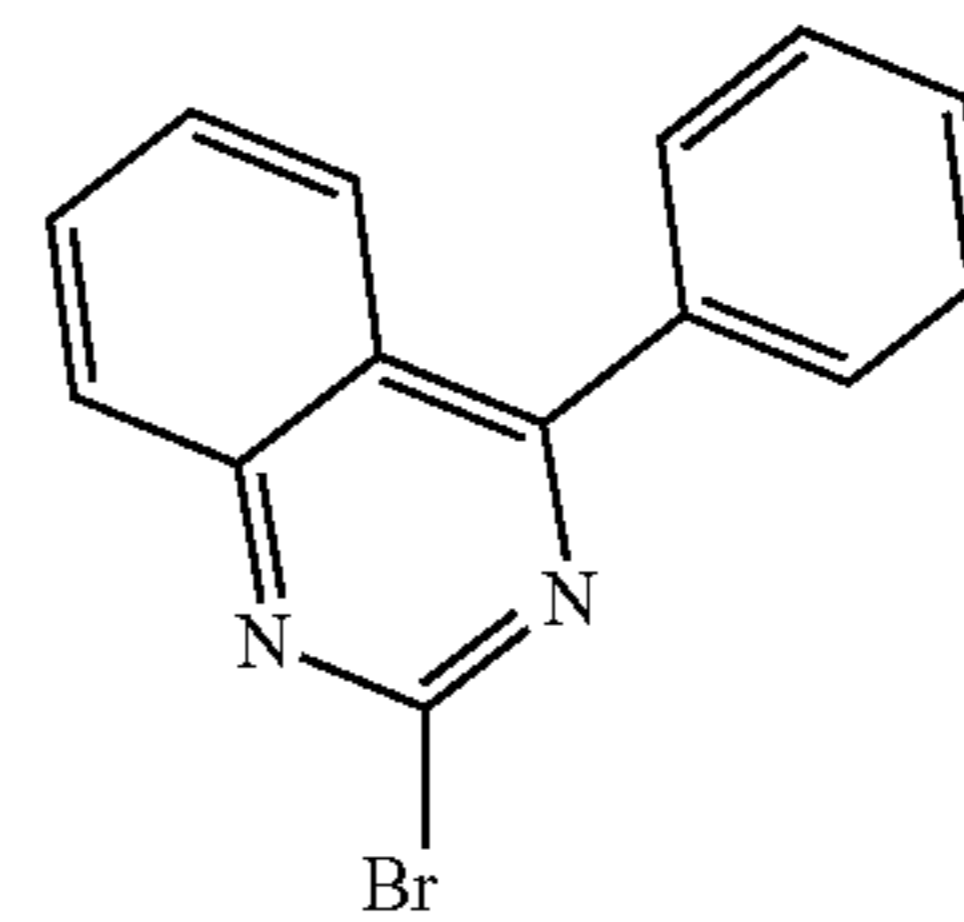
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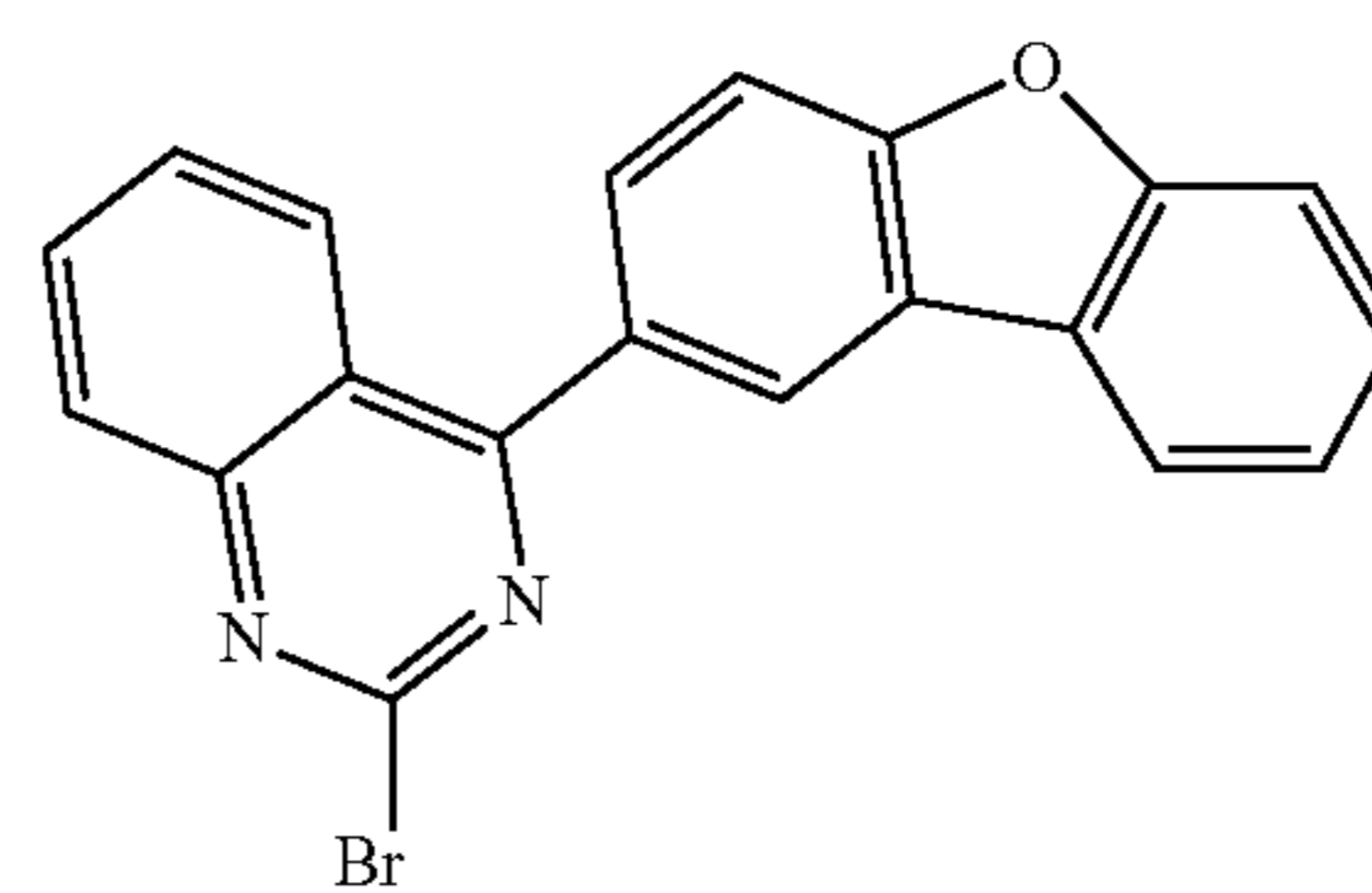
Sub 4-11

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Sub 4-12

Sub 4-13

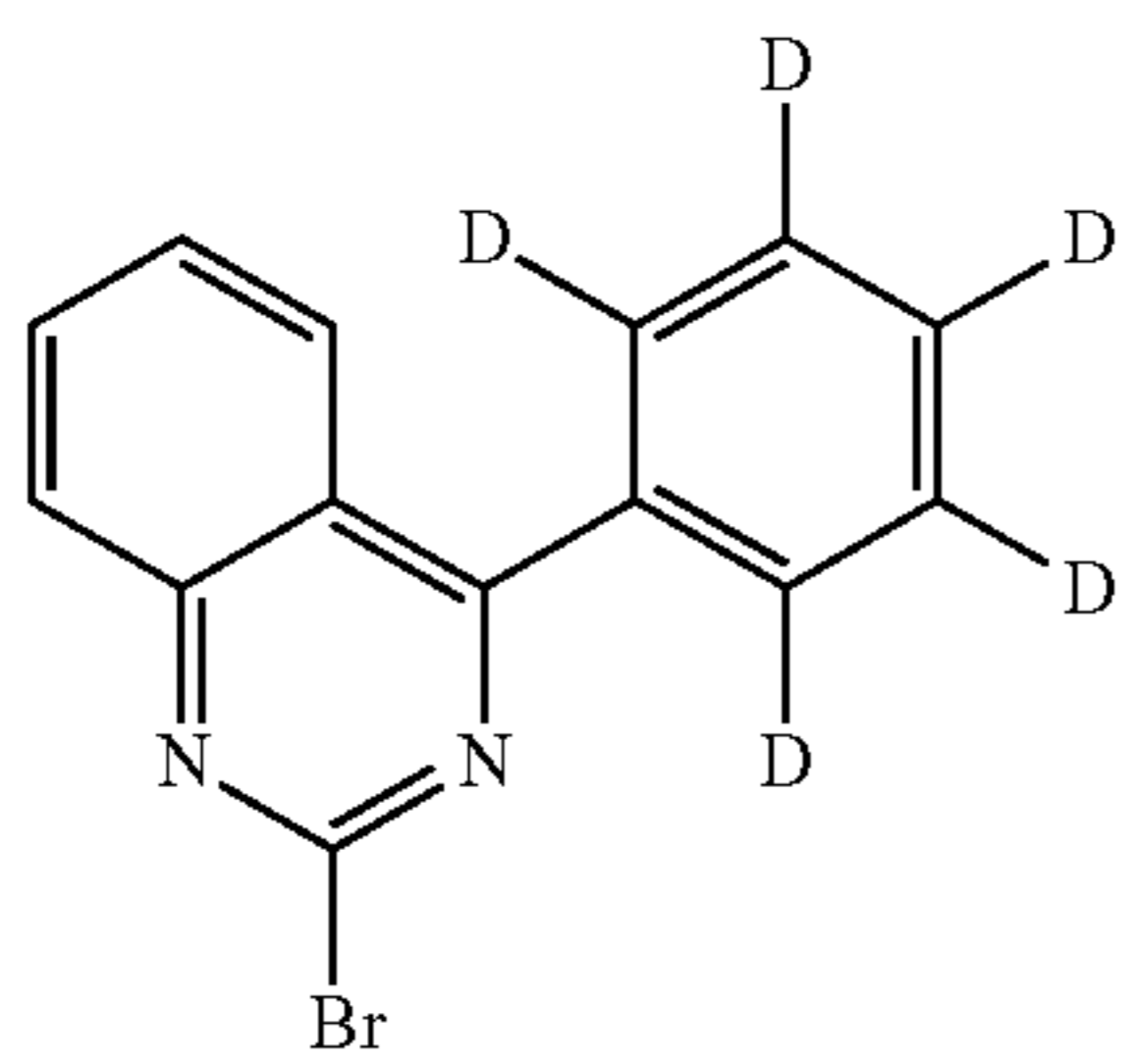
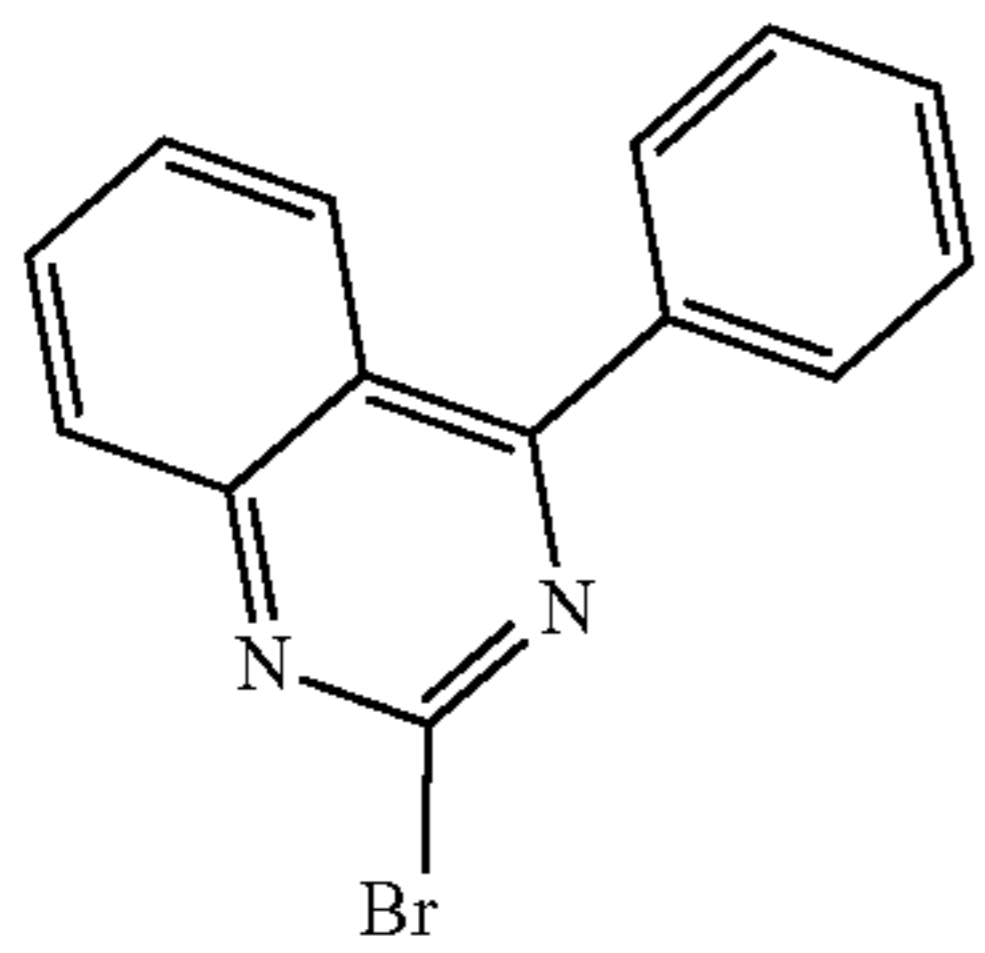
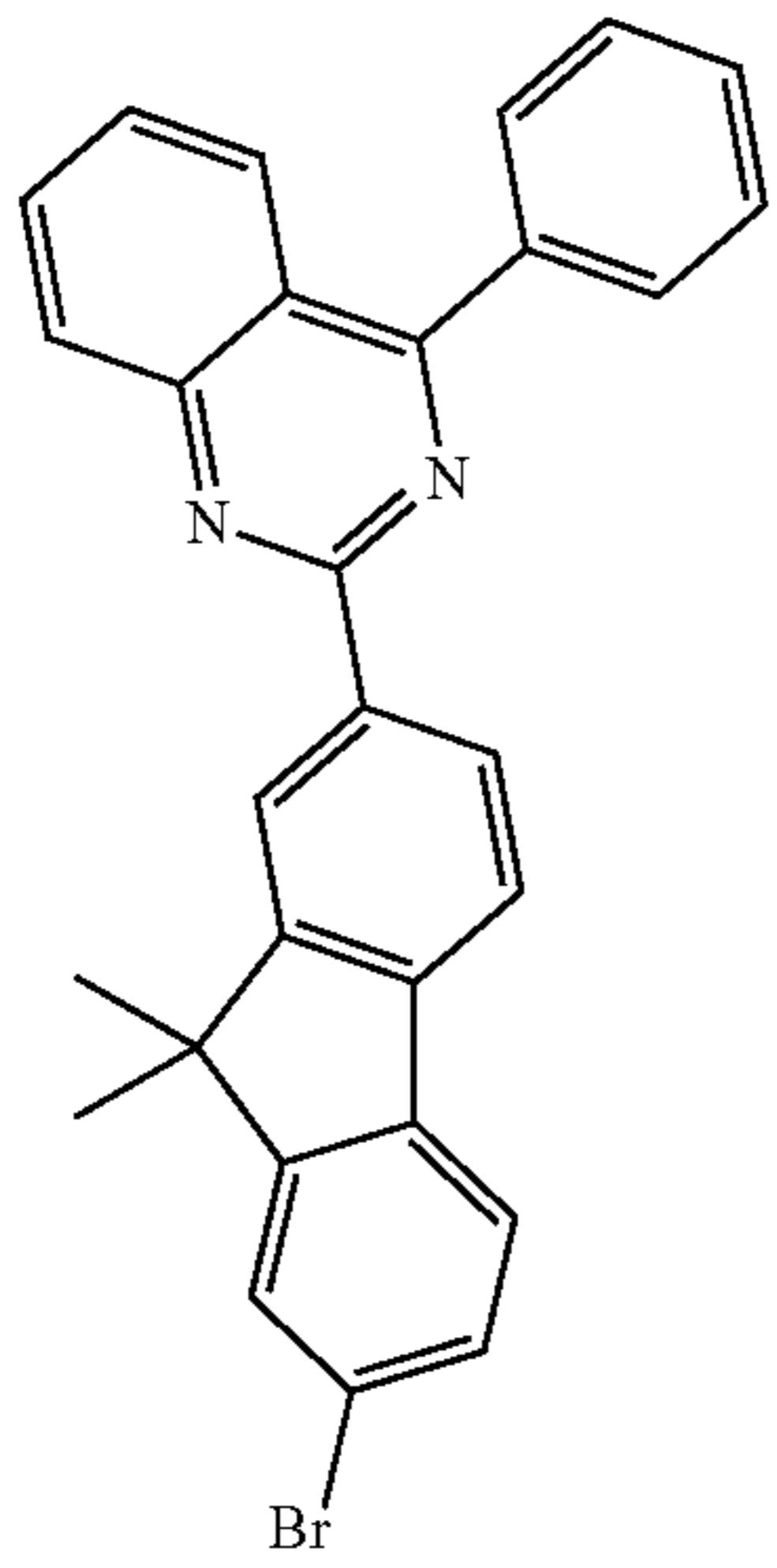
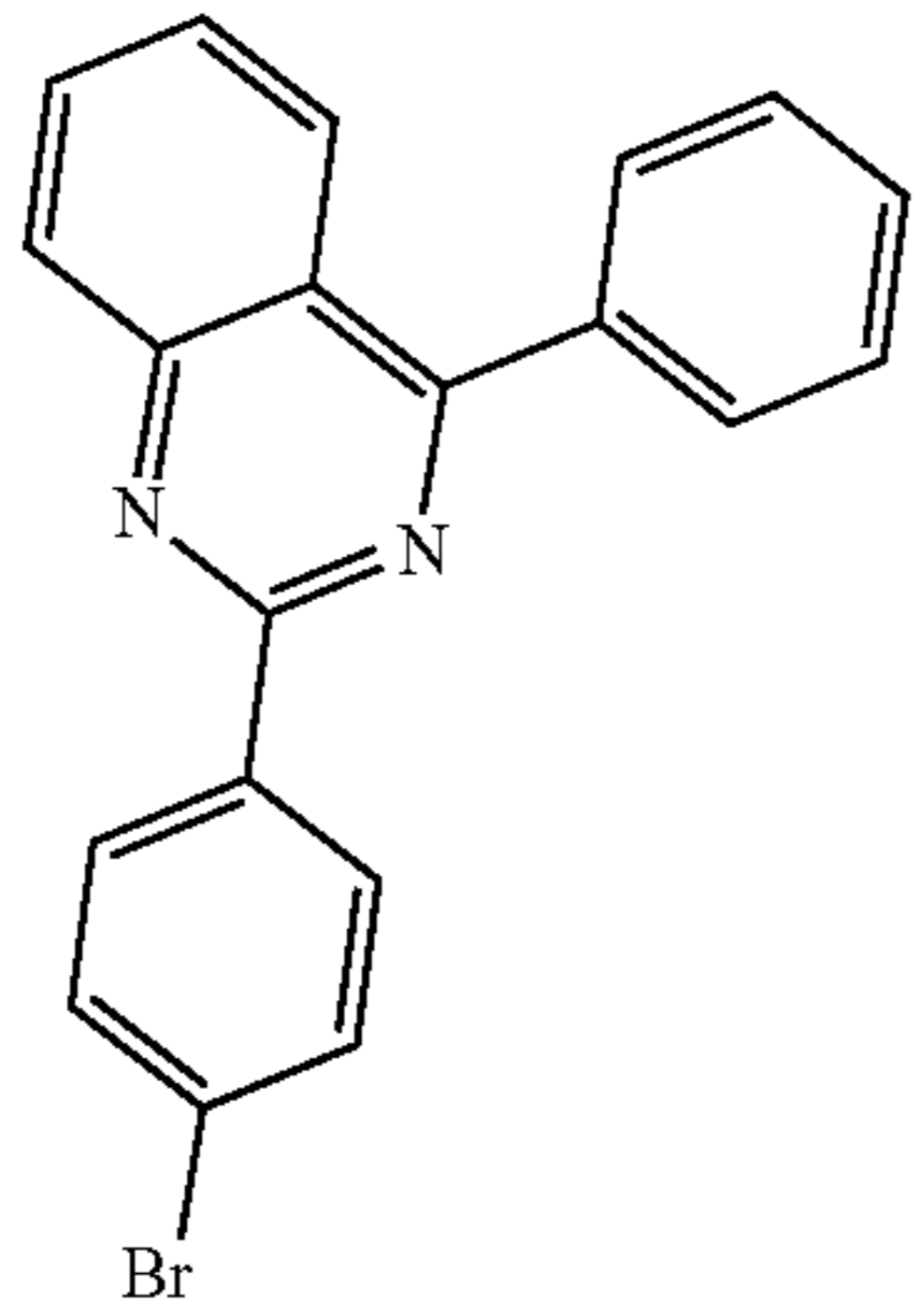
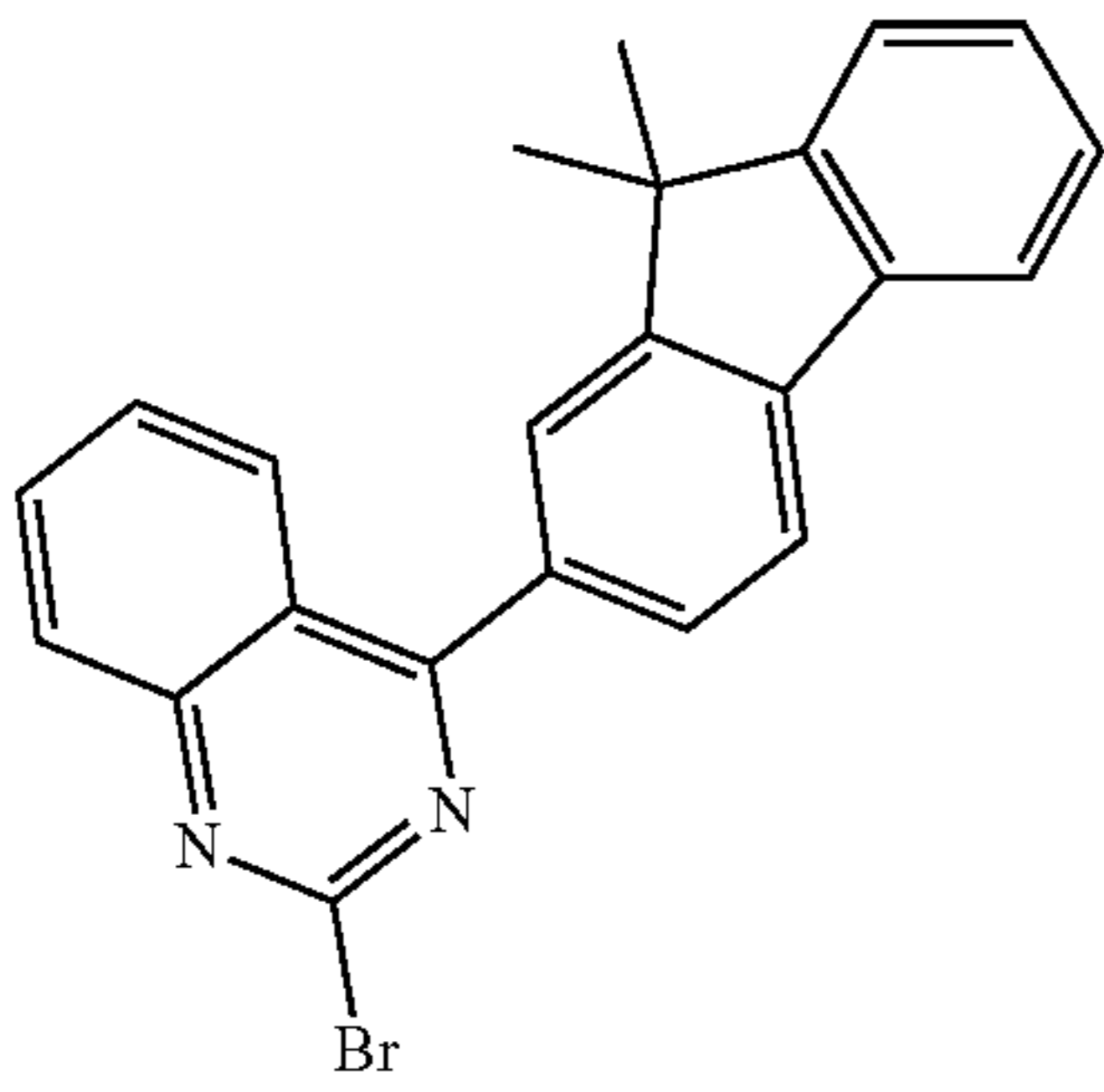
Sub 4-14

Sub 4-15

Sub 4-16

**141**

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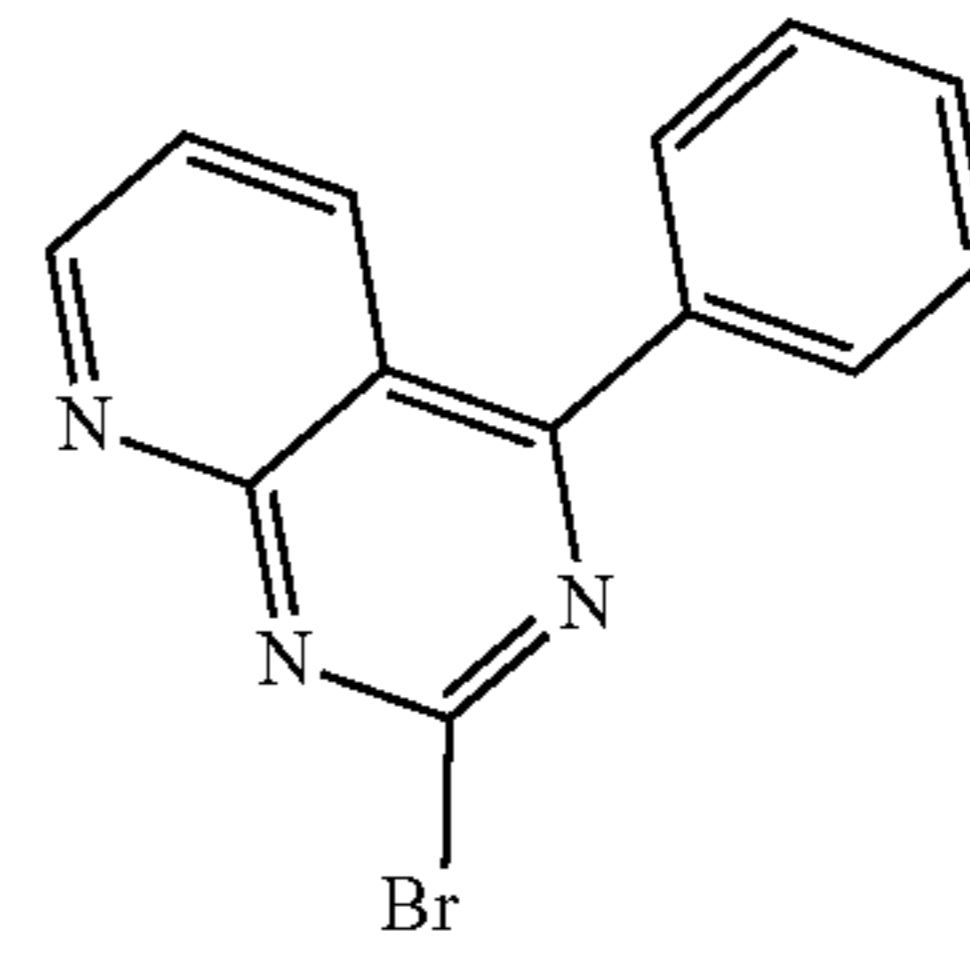


**142**

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Sub 4-17

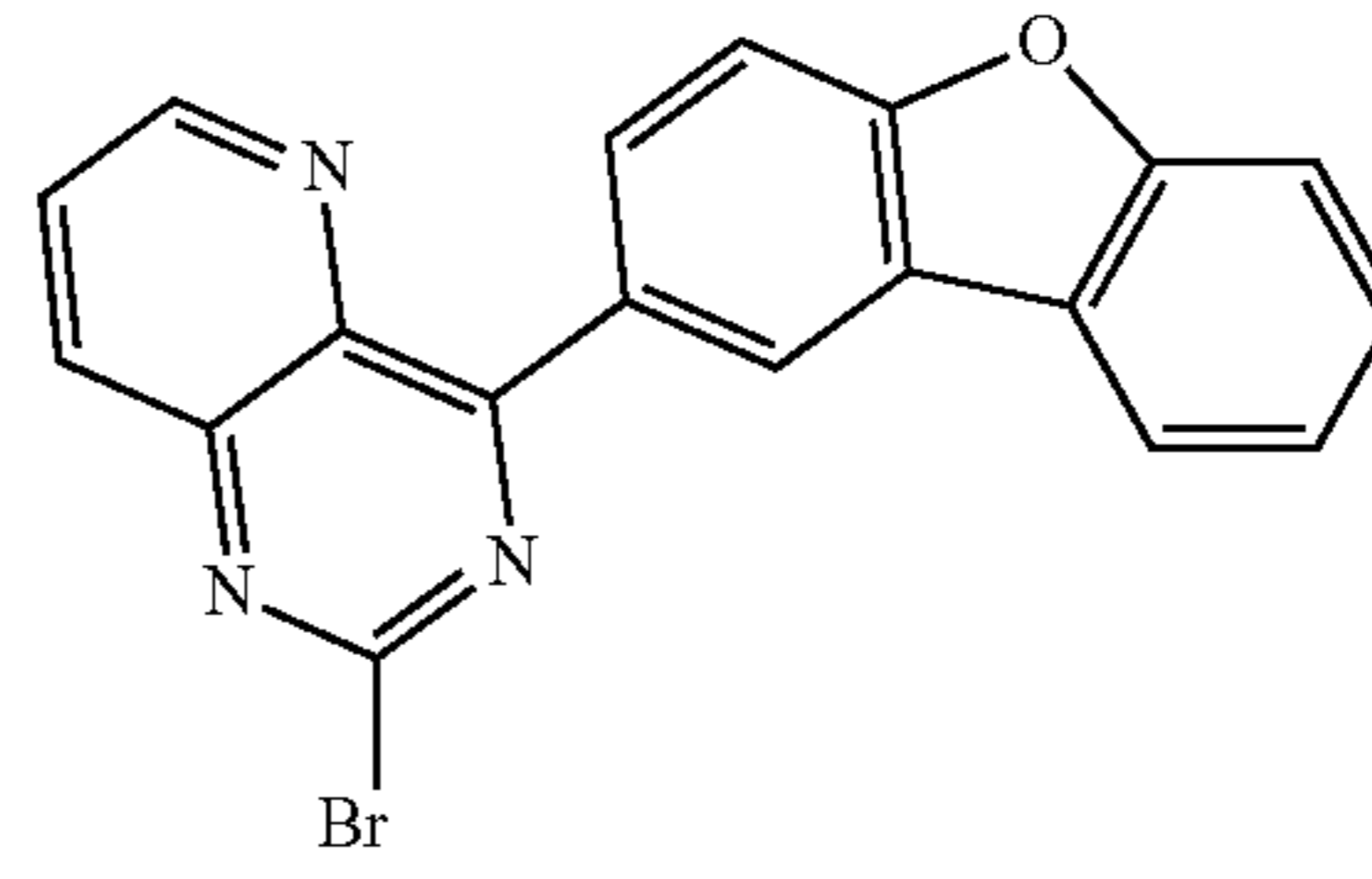
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Sub 4-22

Sub 4-18

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Sub 4-23

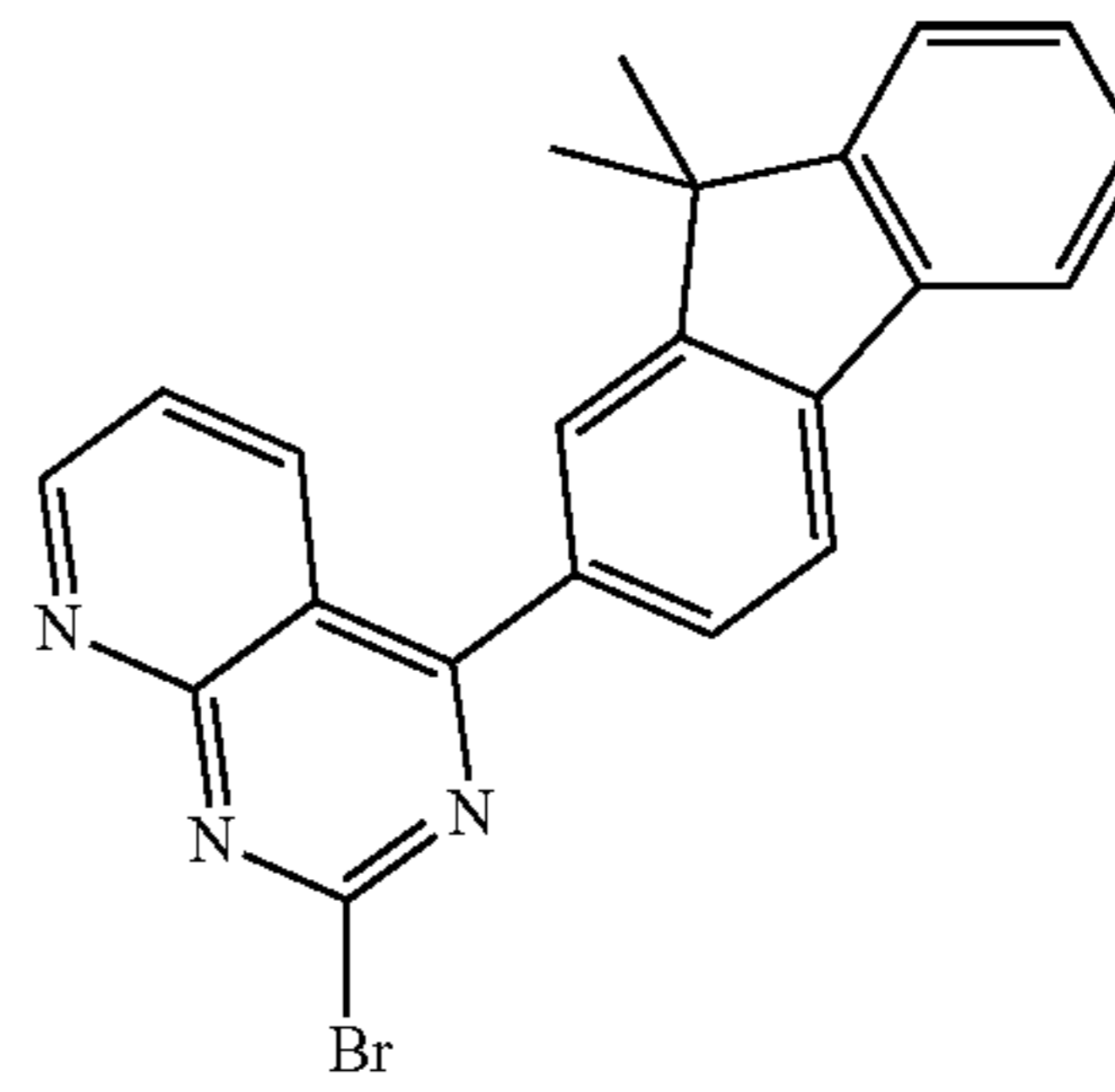
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Sub 4-24

Sub 4-19

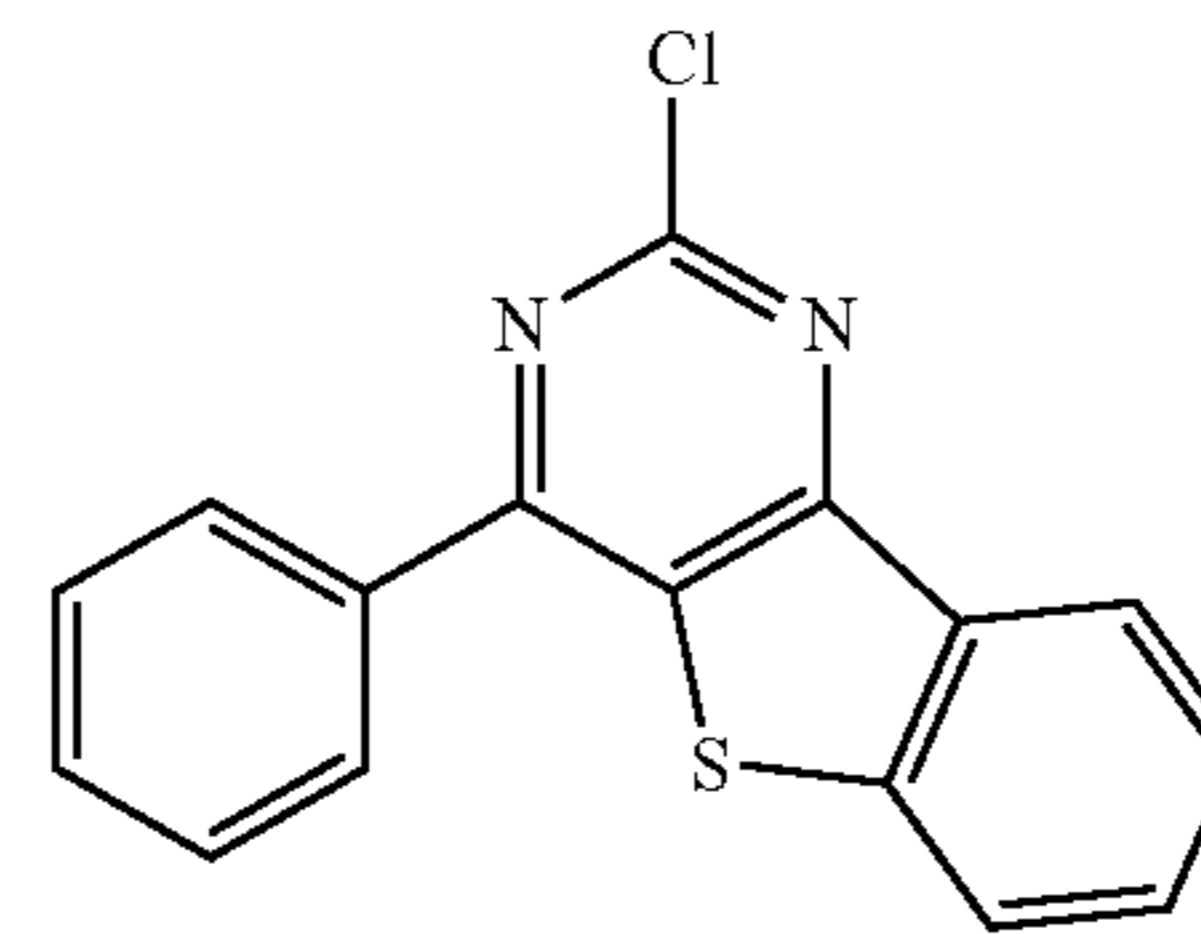
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Sub 4-25

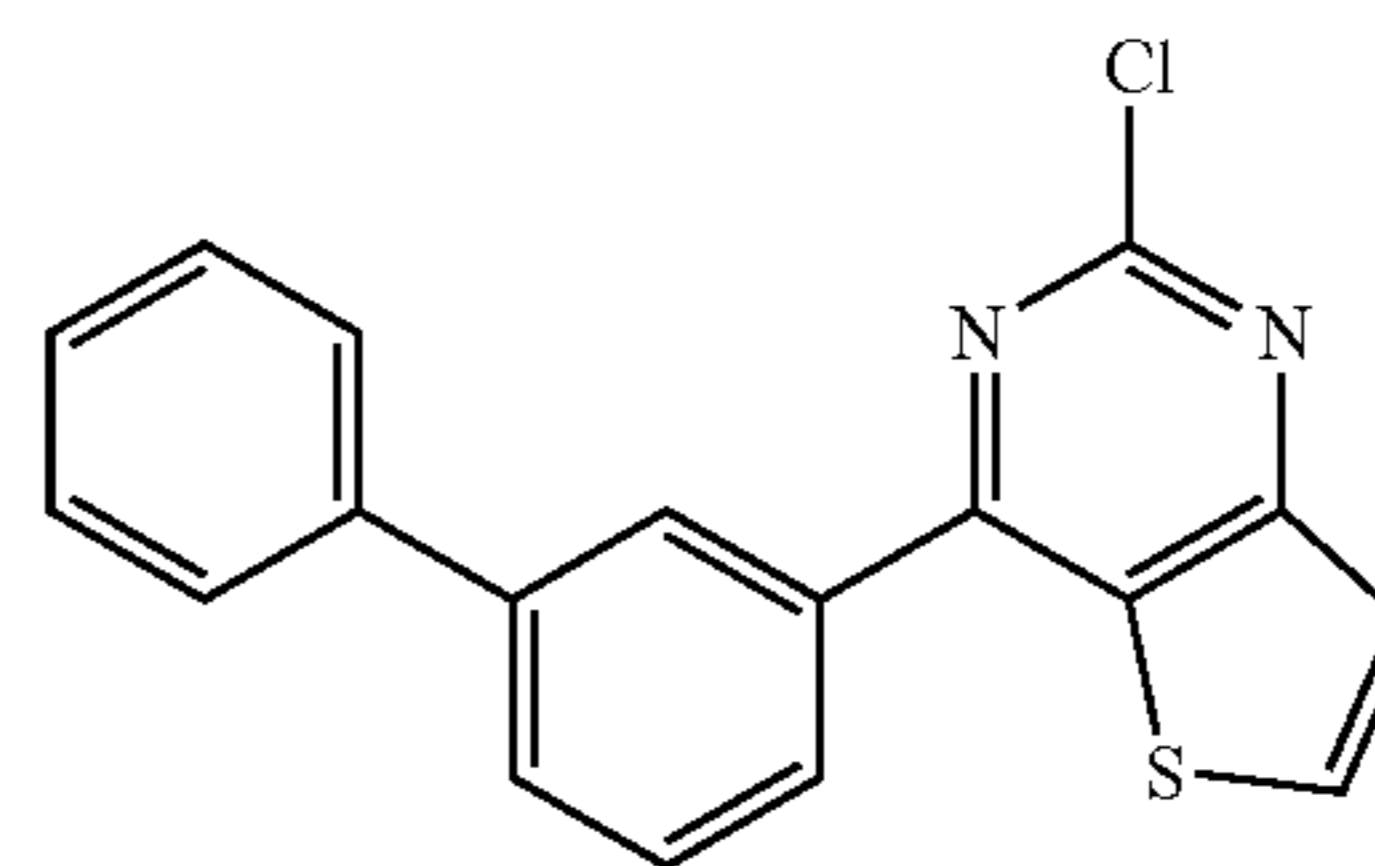
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Sub 4-20

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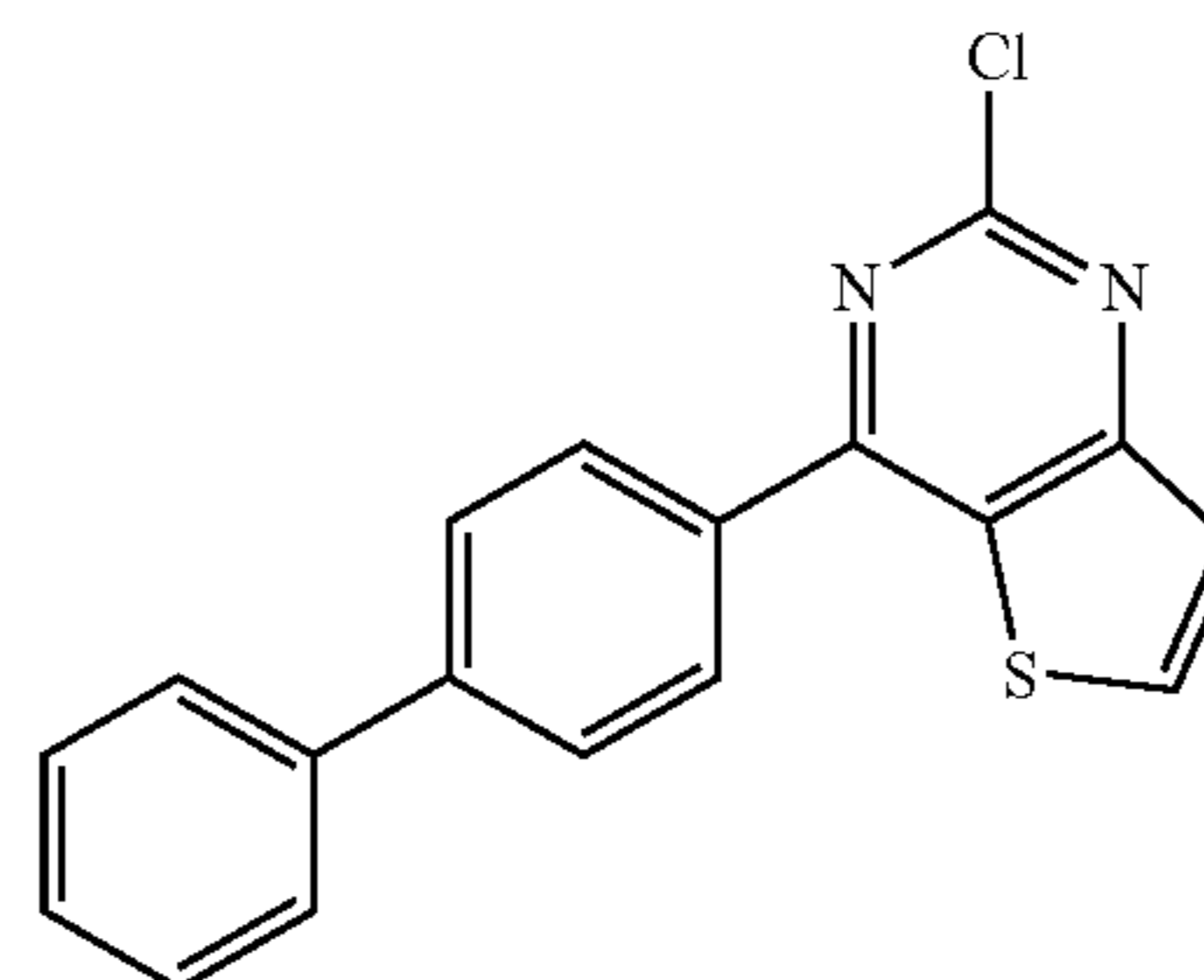


Sub 4-26

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Sub 4-21

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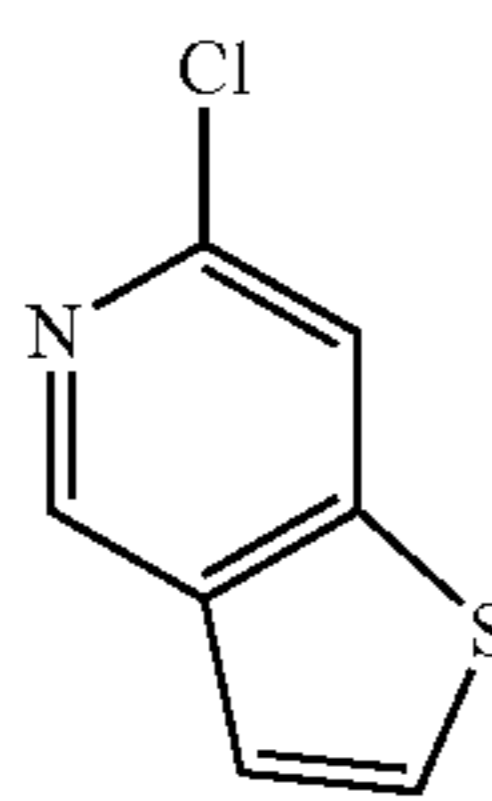
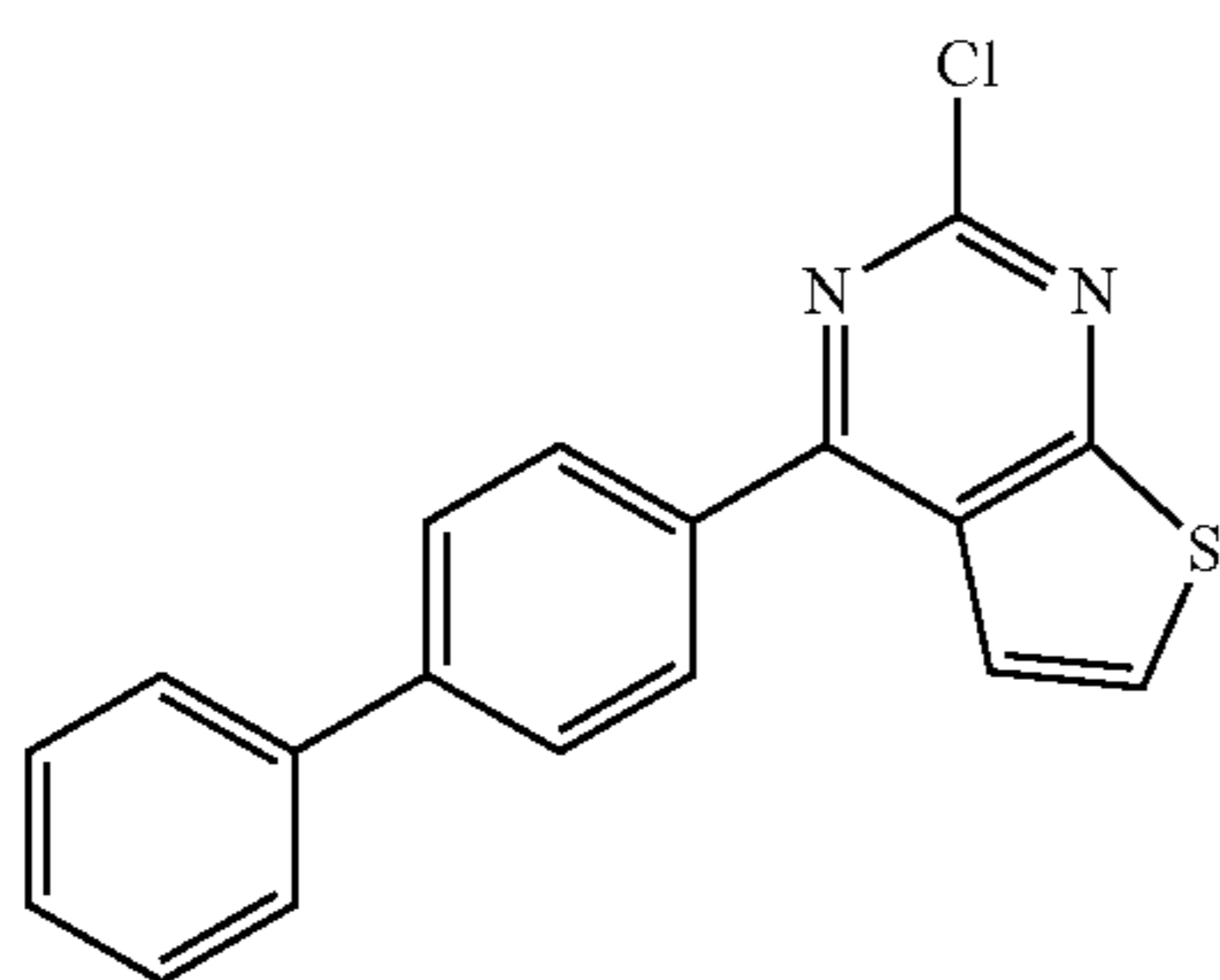
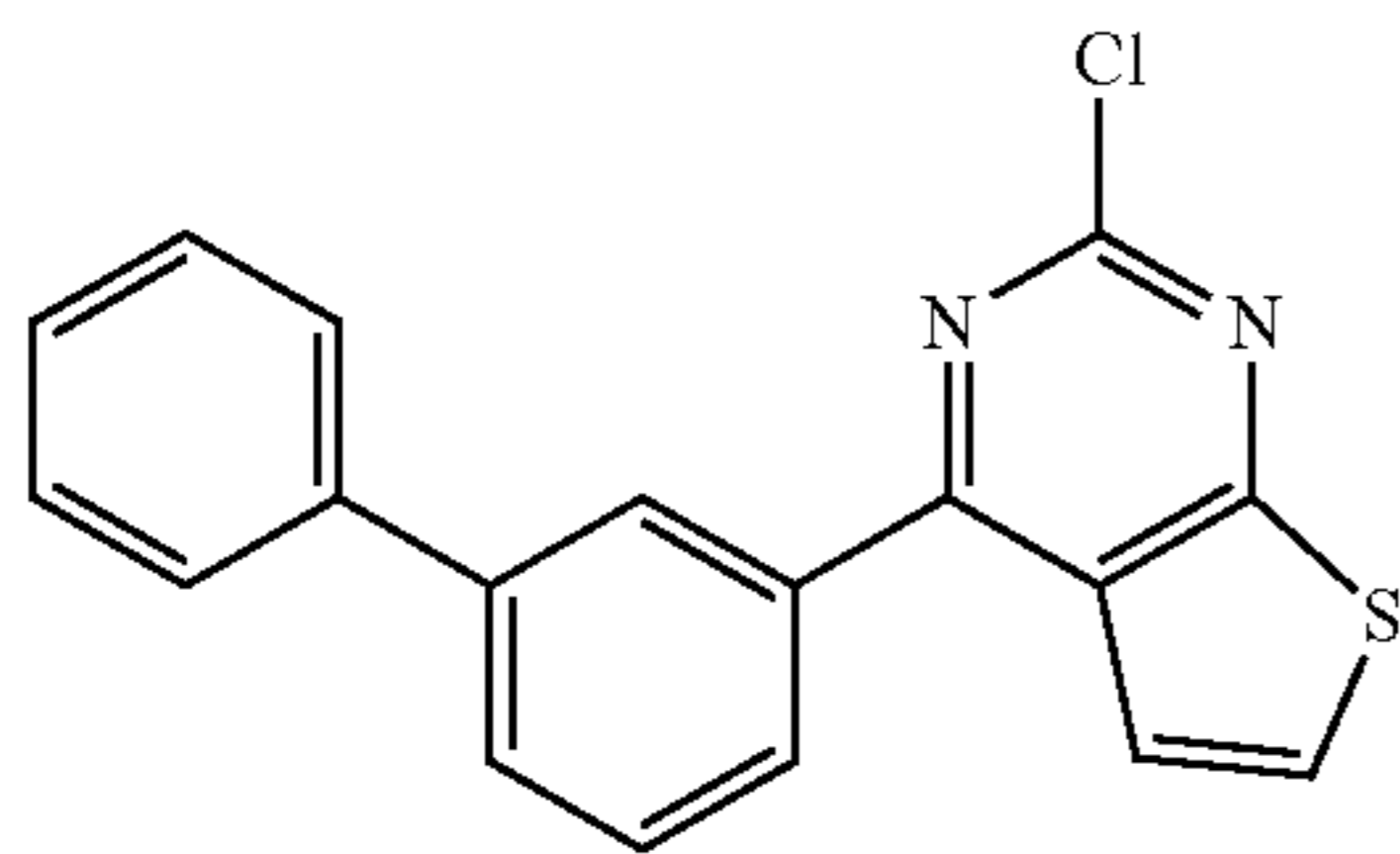
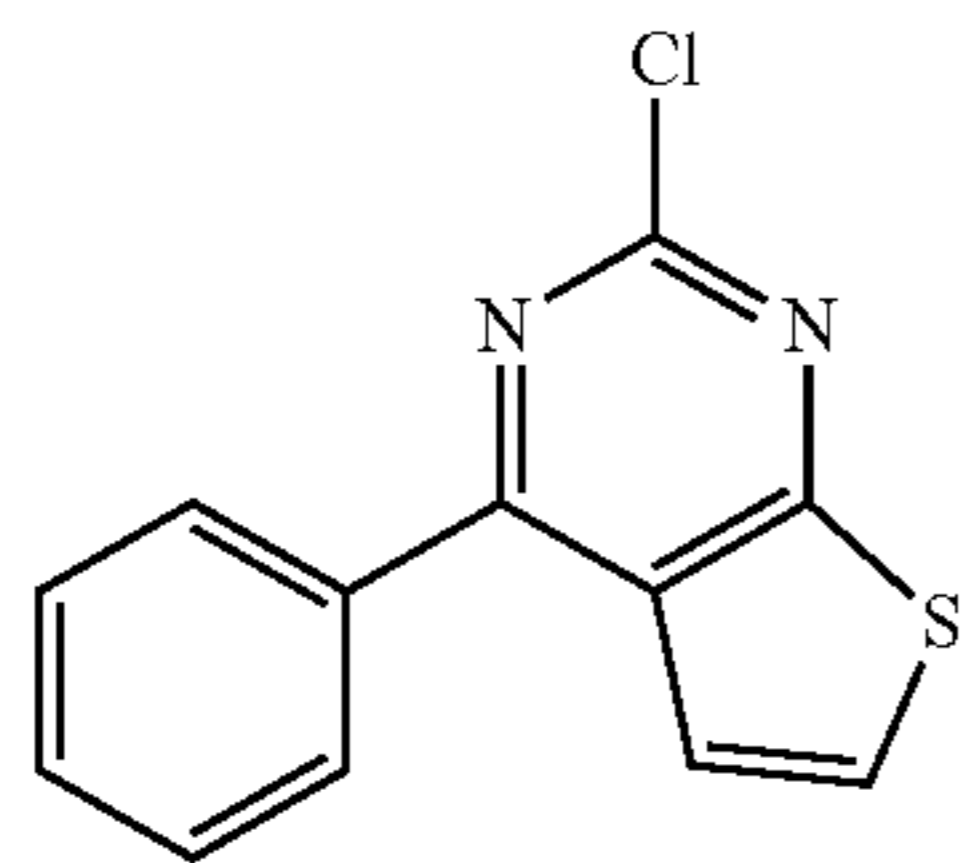
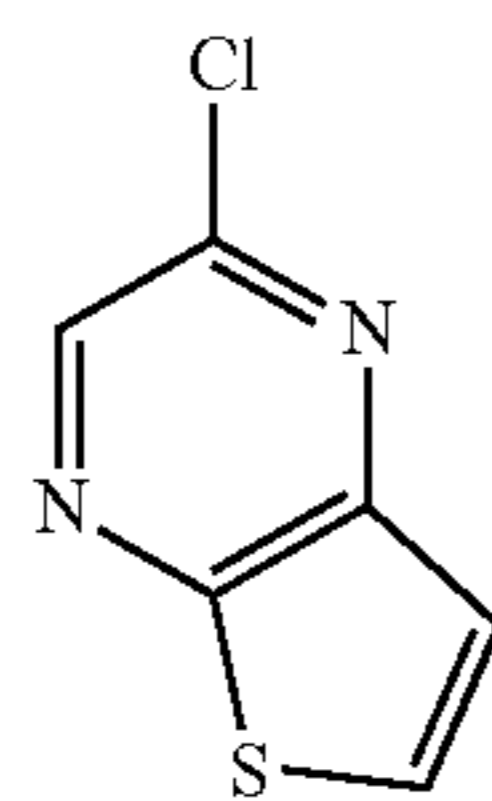
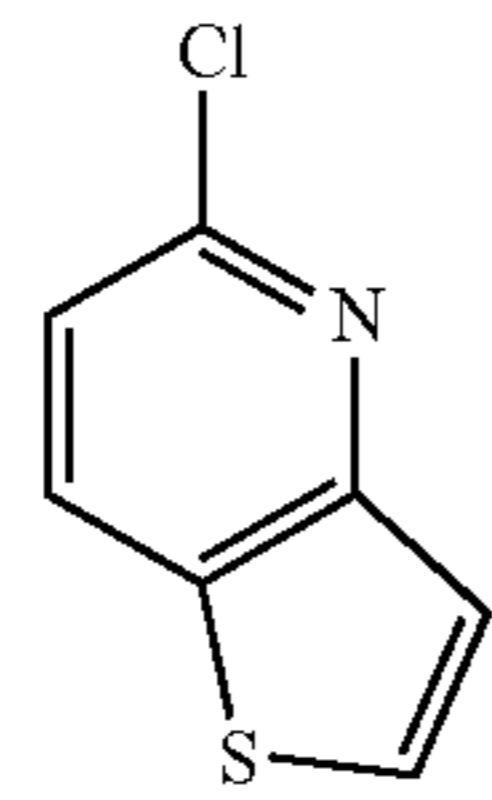
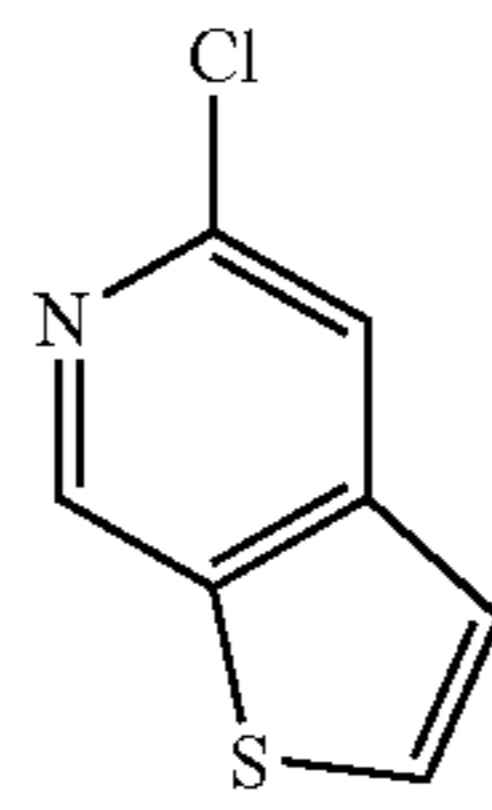


Sub 4-27

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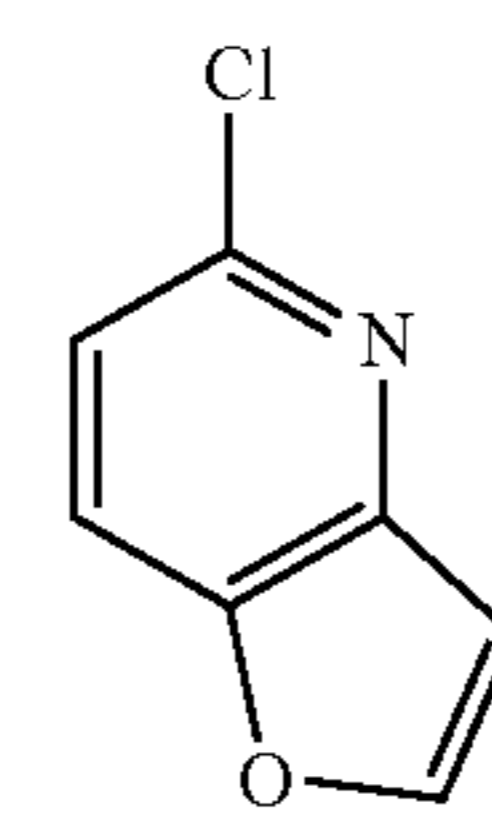
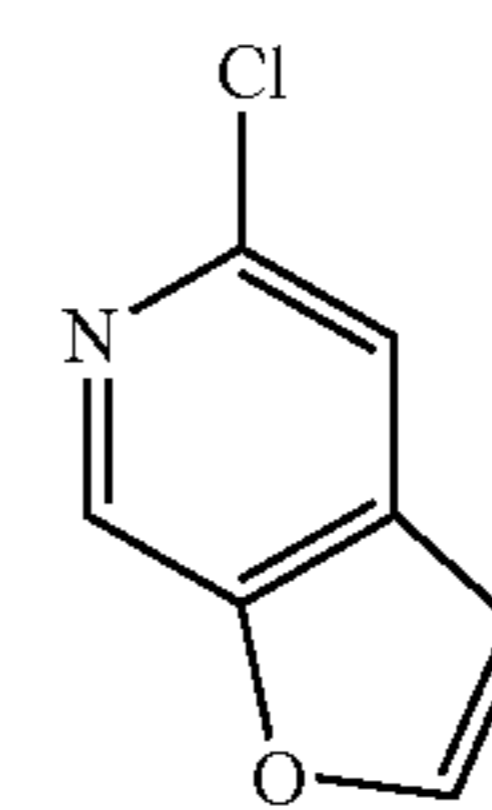
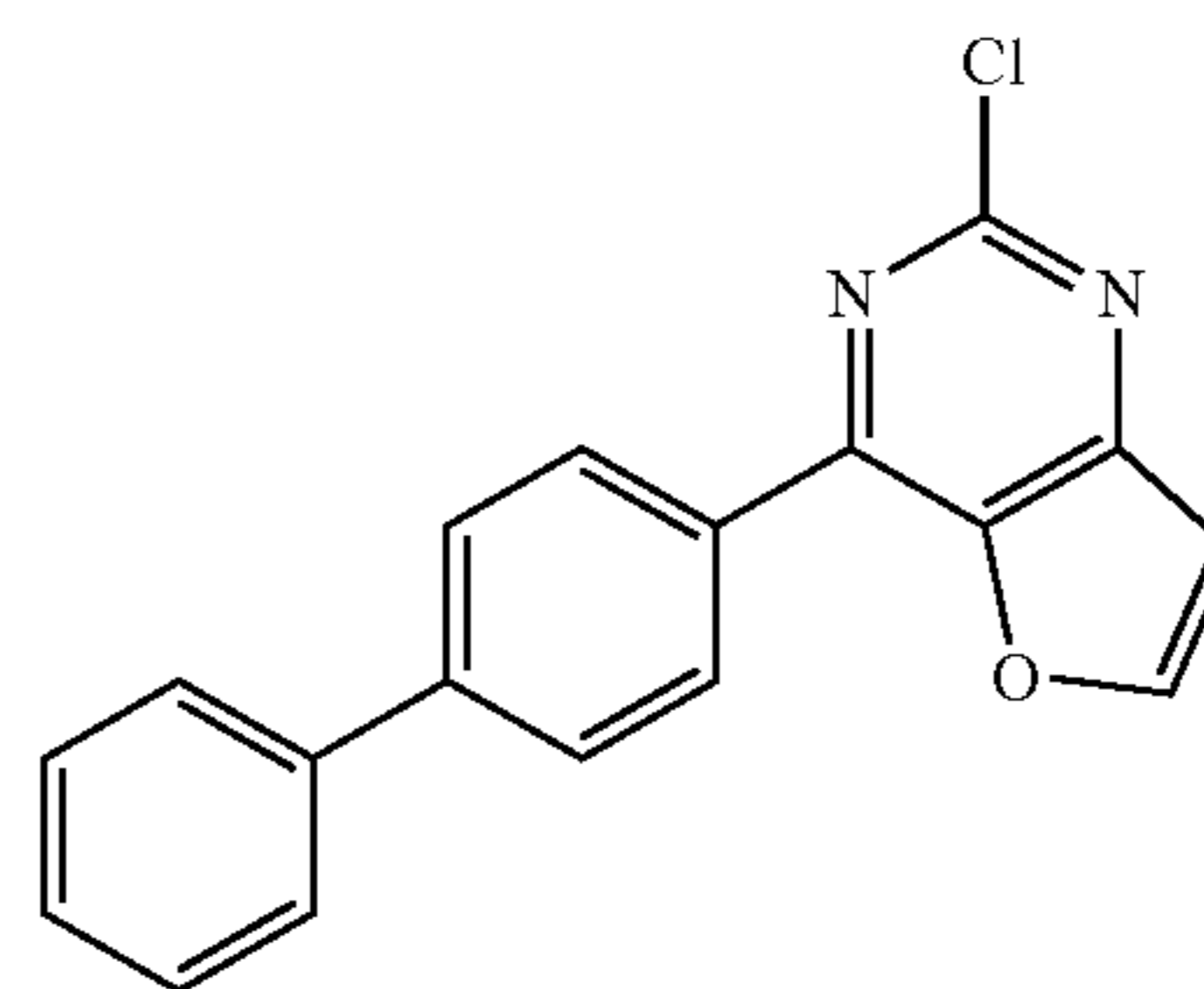
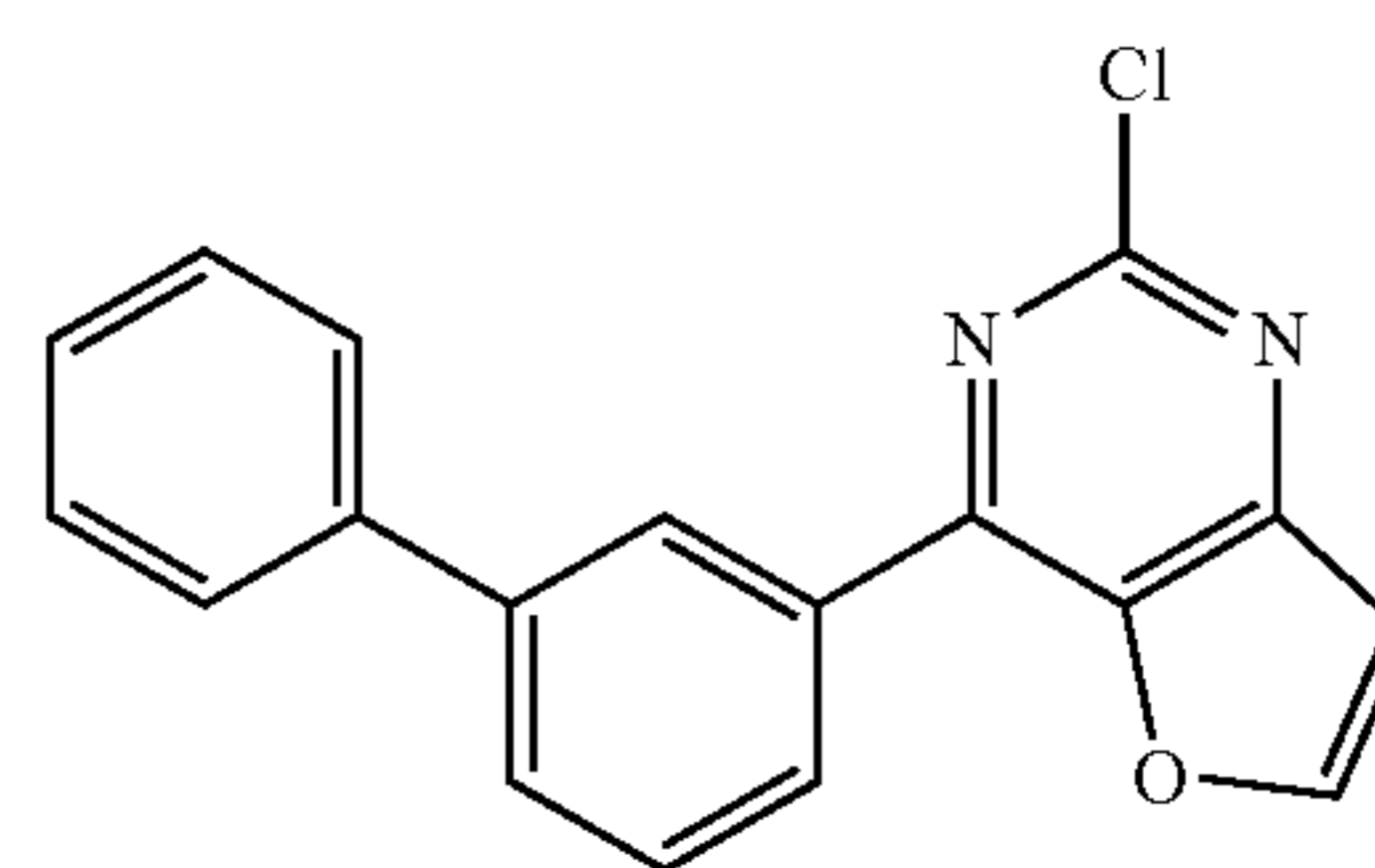
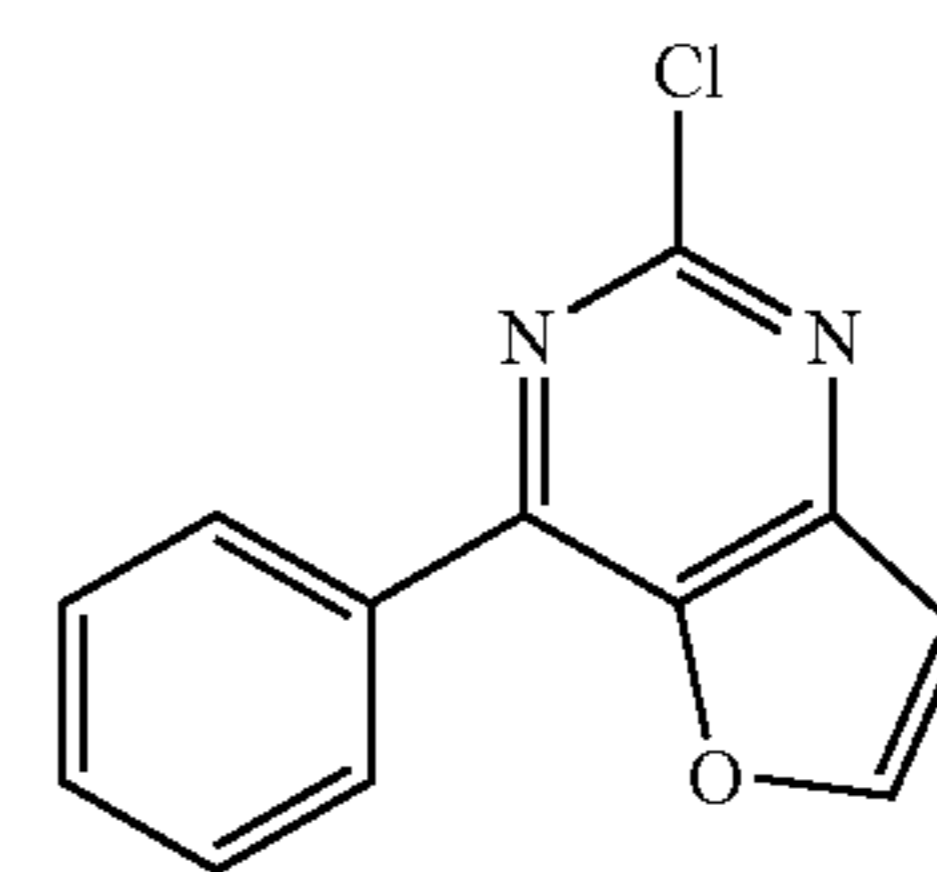
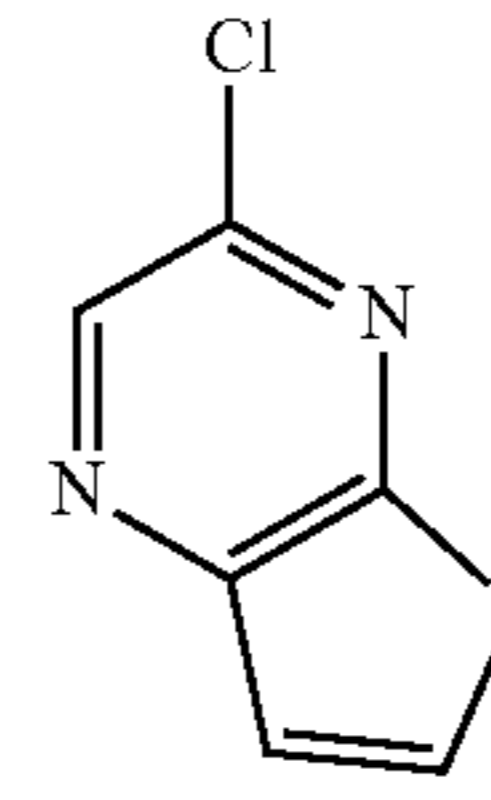
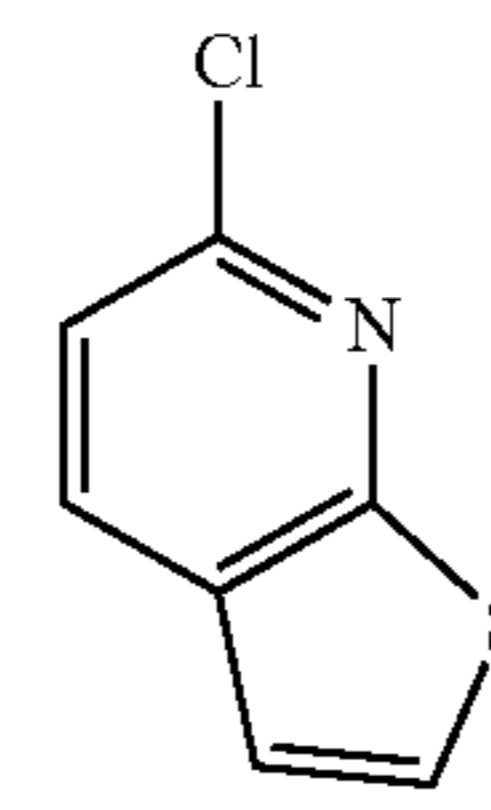
**143**

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**144**

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Sub 4-28

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Sub 4-29

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Sub 4-30

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Sub 4-31

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Sub 4-32

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Sub 4-33

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Sub 4-34

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Sub 4-35

Sub 4-36

Sub 4-25

Sub 4-26

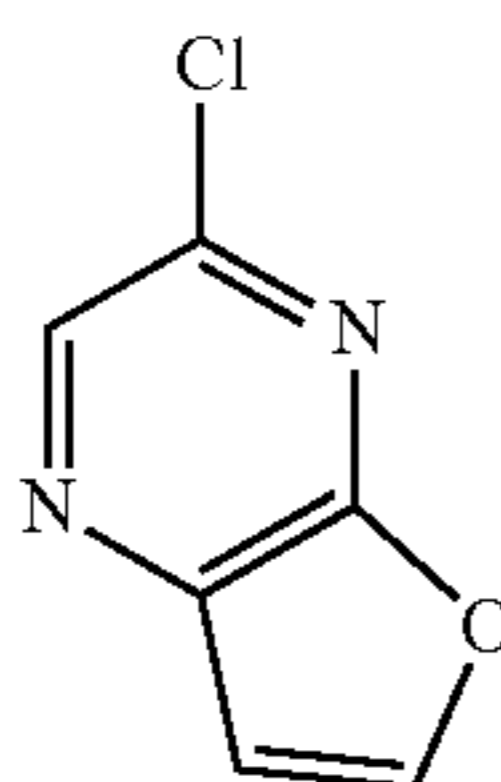
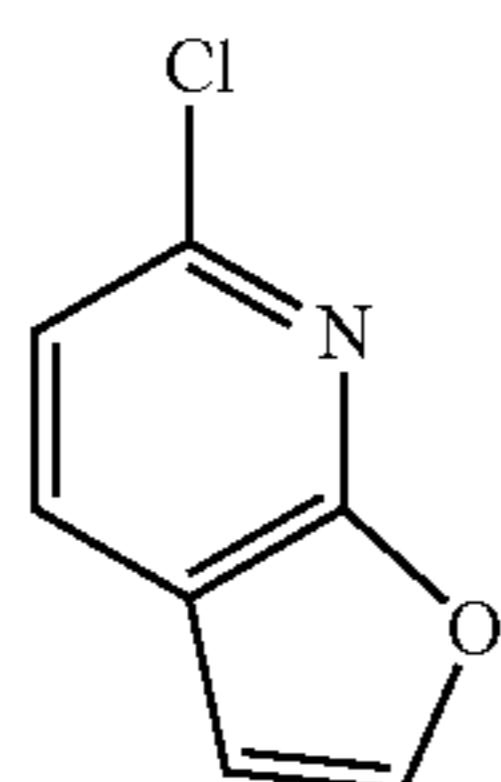
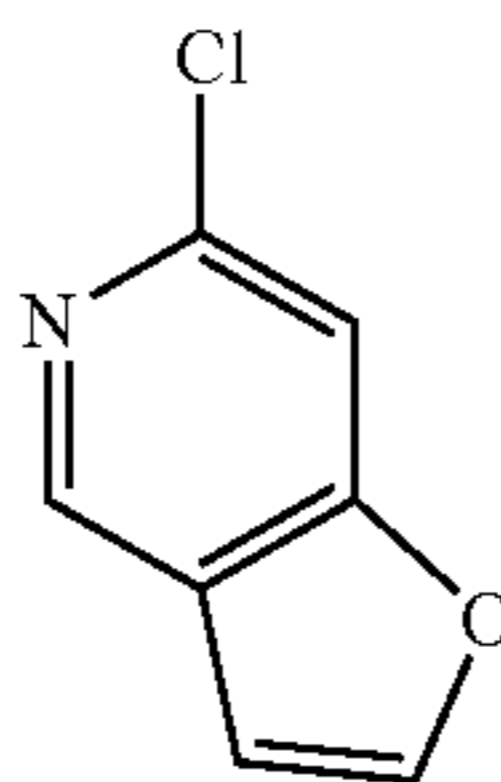
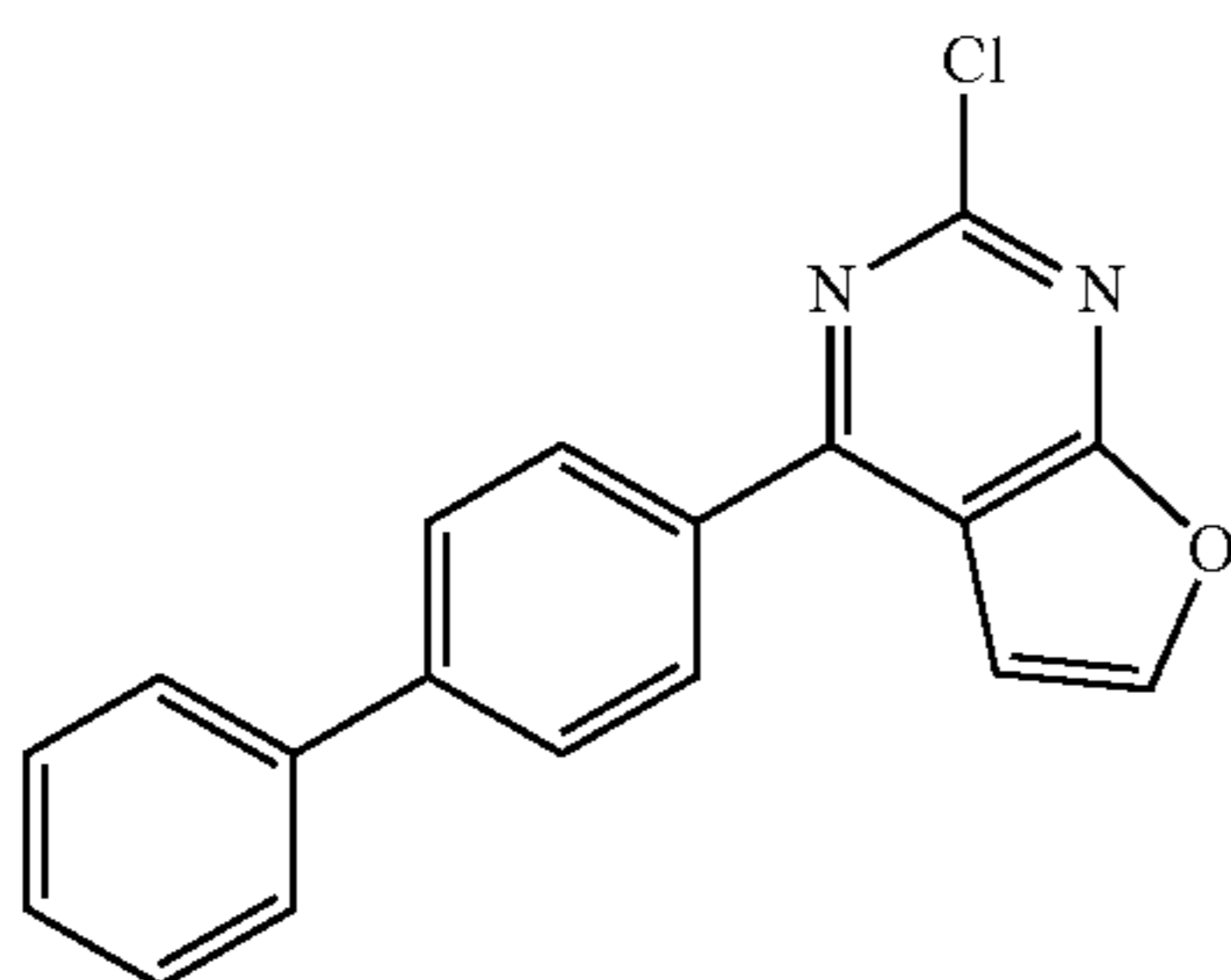
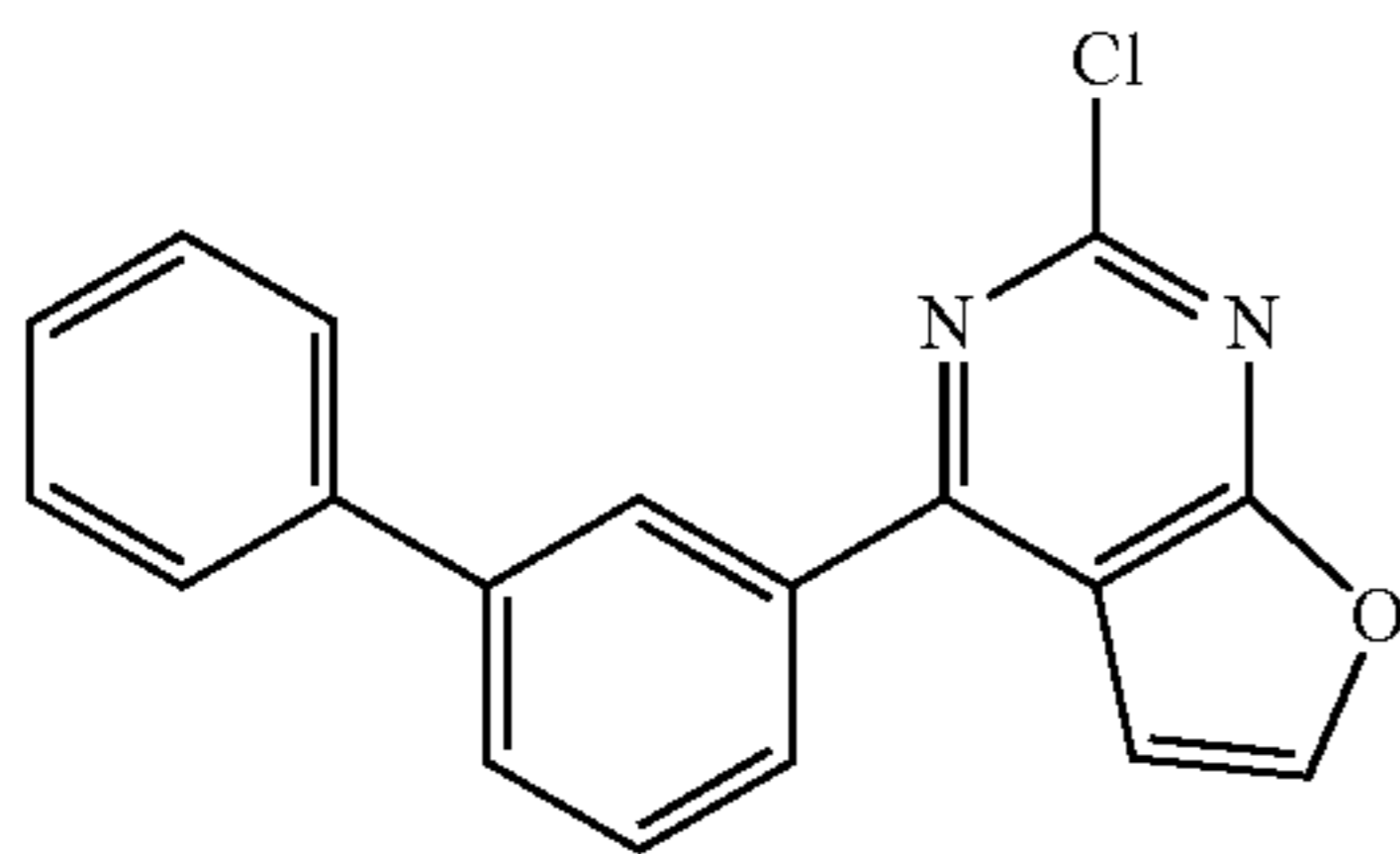
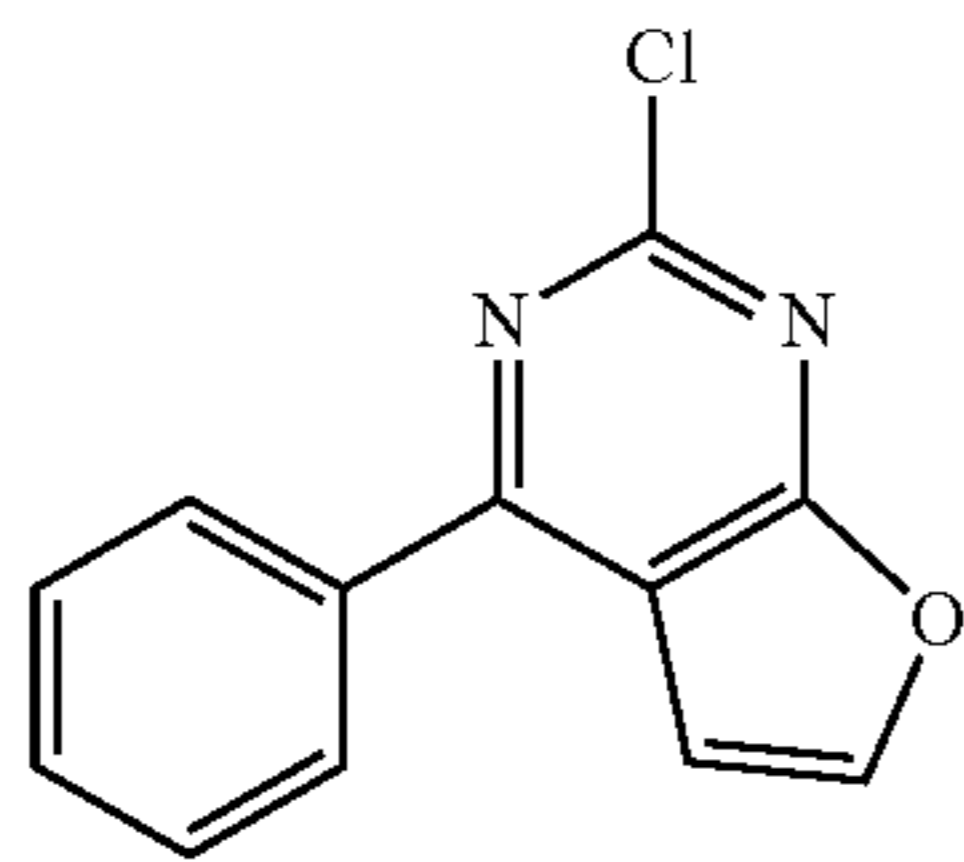
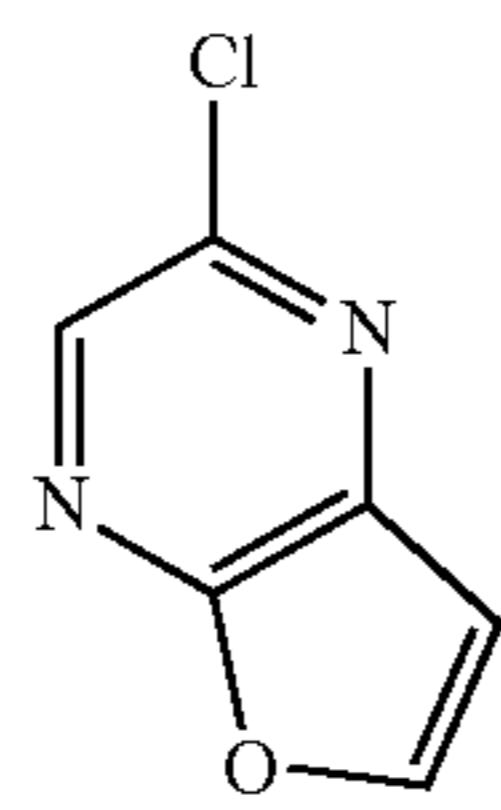
Sub 4-27

Sub 4-28

Sub 4-29

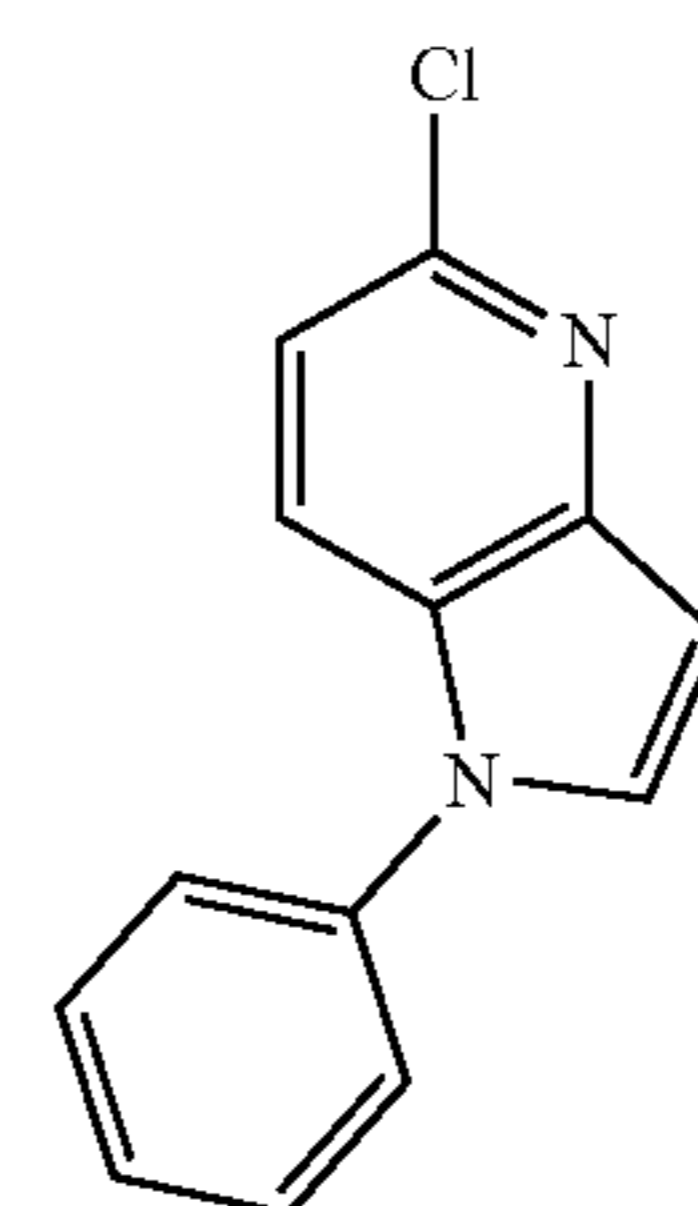
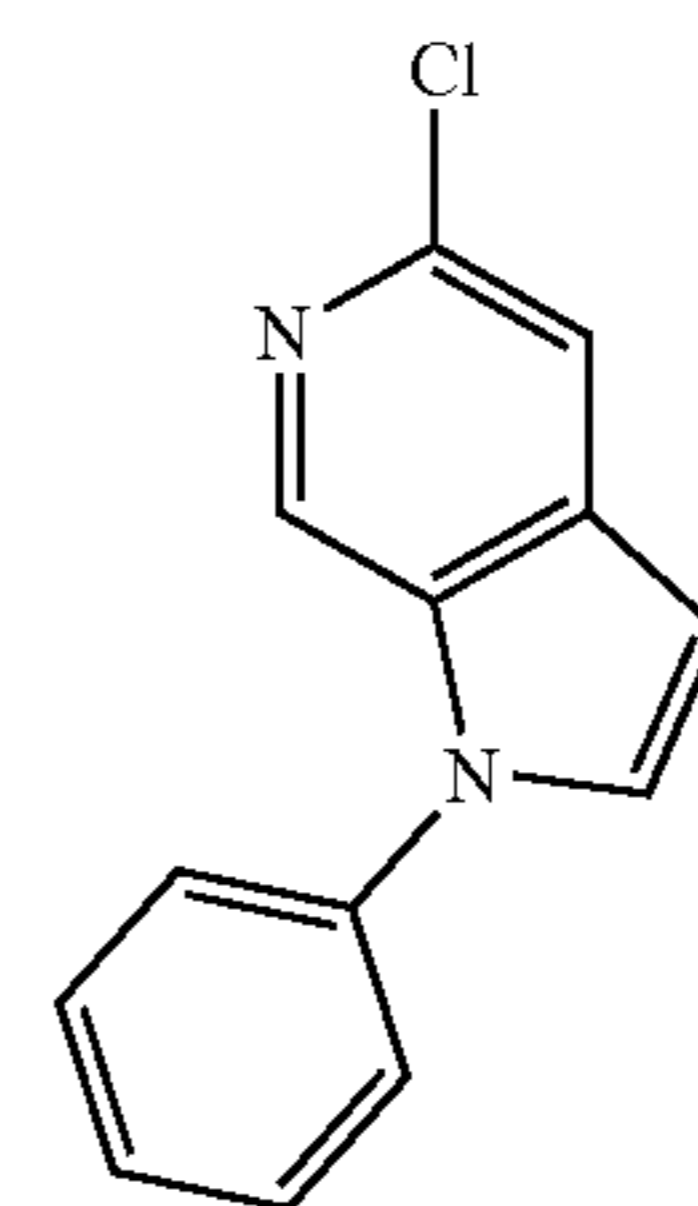
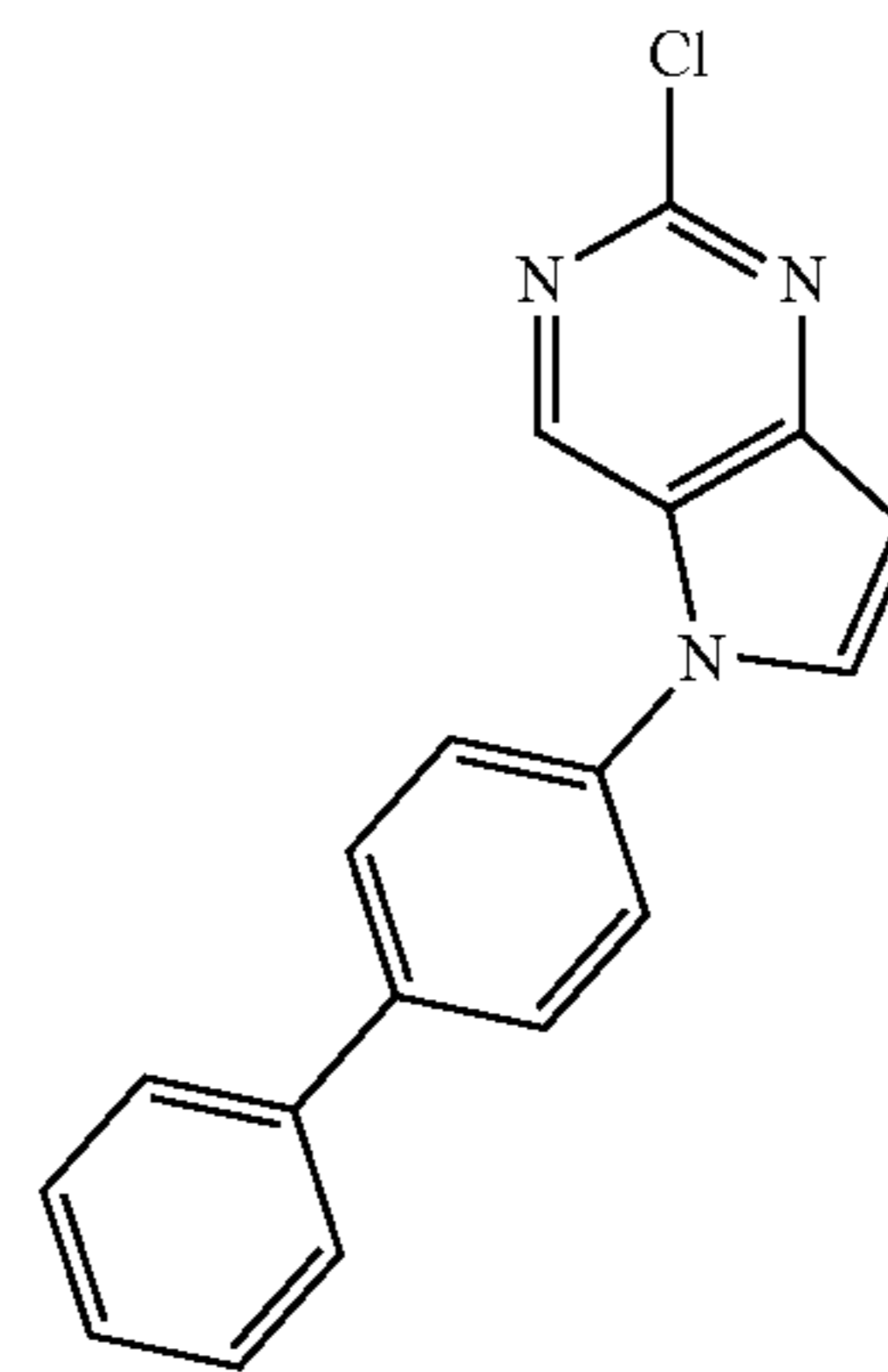
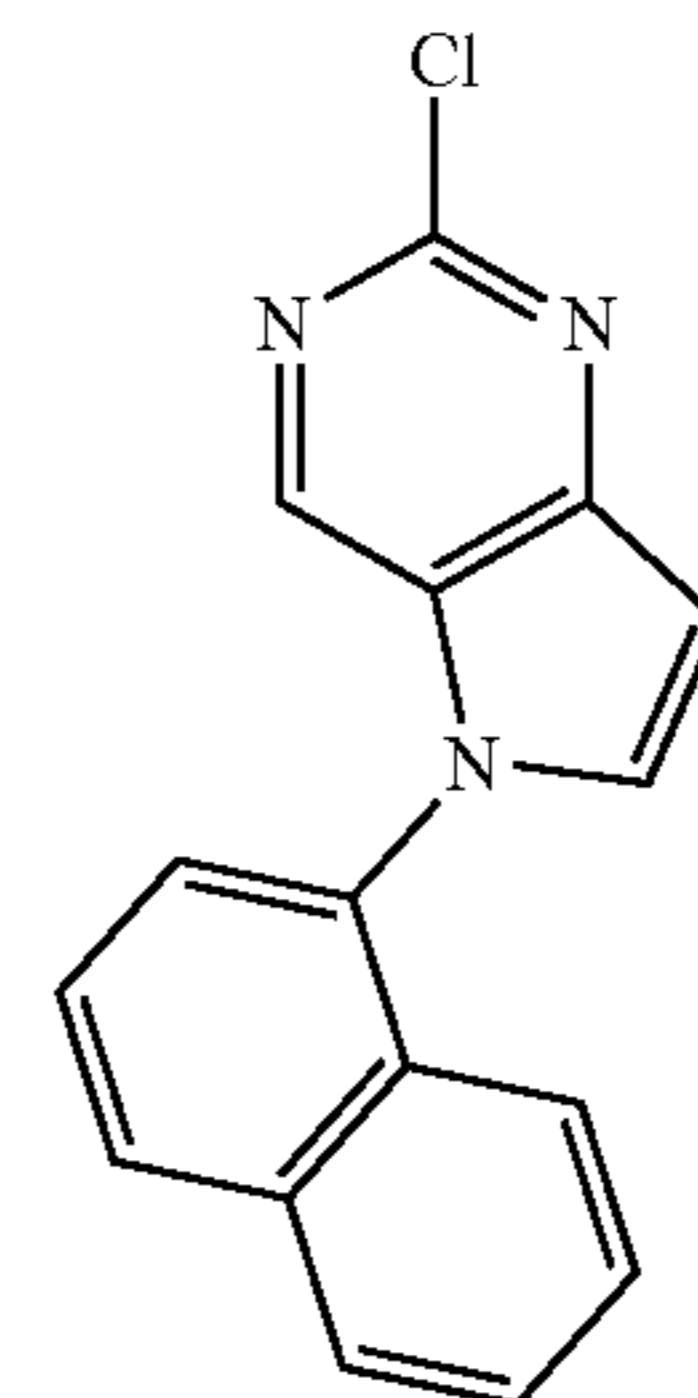
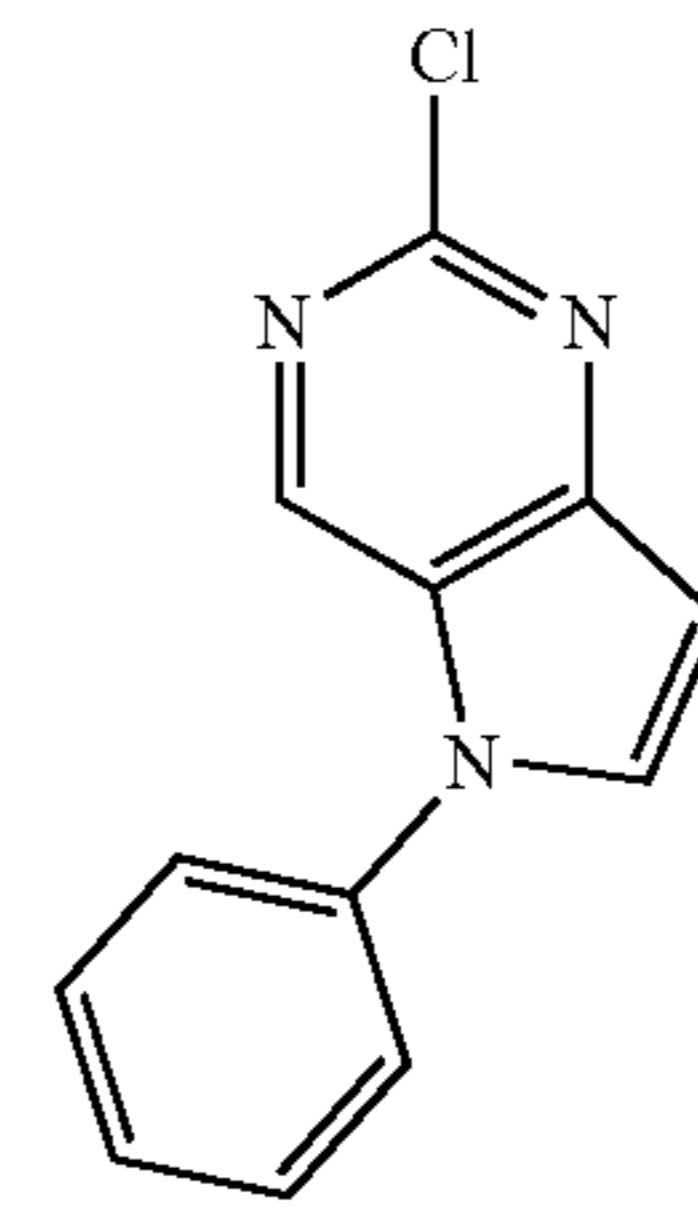
**145**

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**146**

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Sub 4-30

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Sub 4-31

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Sub 4-32

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Sub 4-33

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Sub 4-34

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Sub 4-35

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Sub 4-36

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Sub 4-37

Sub 4-38

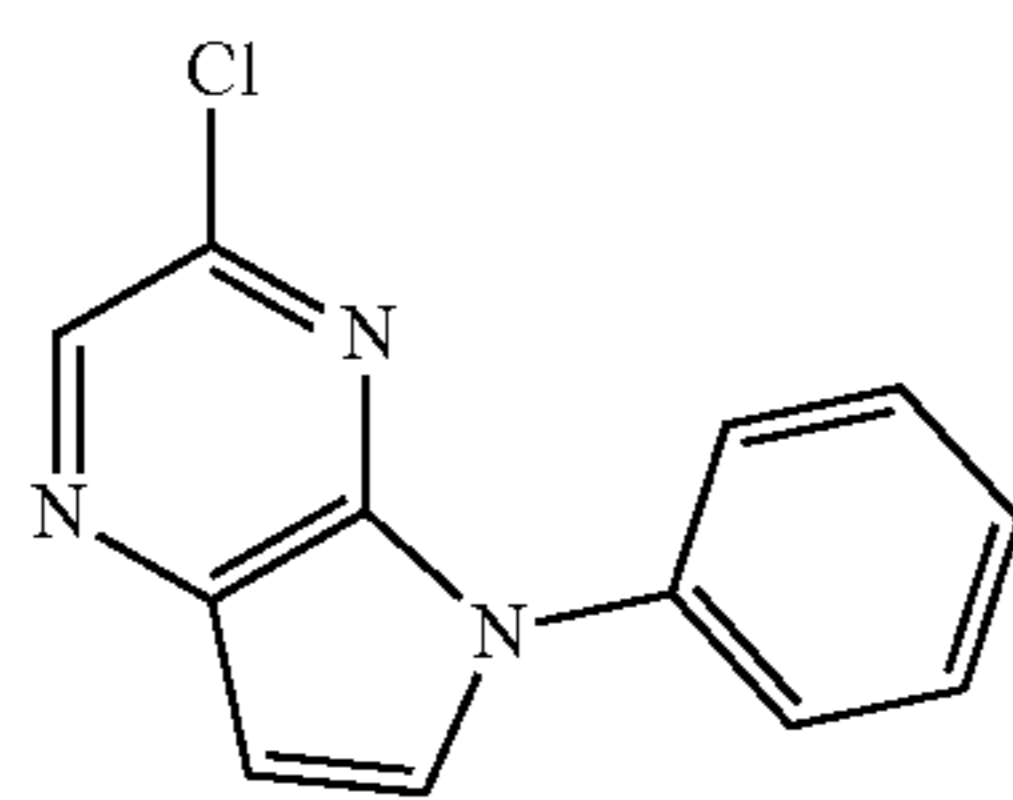
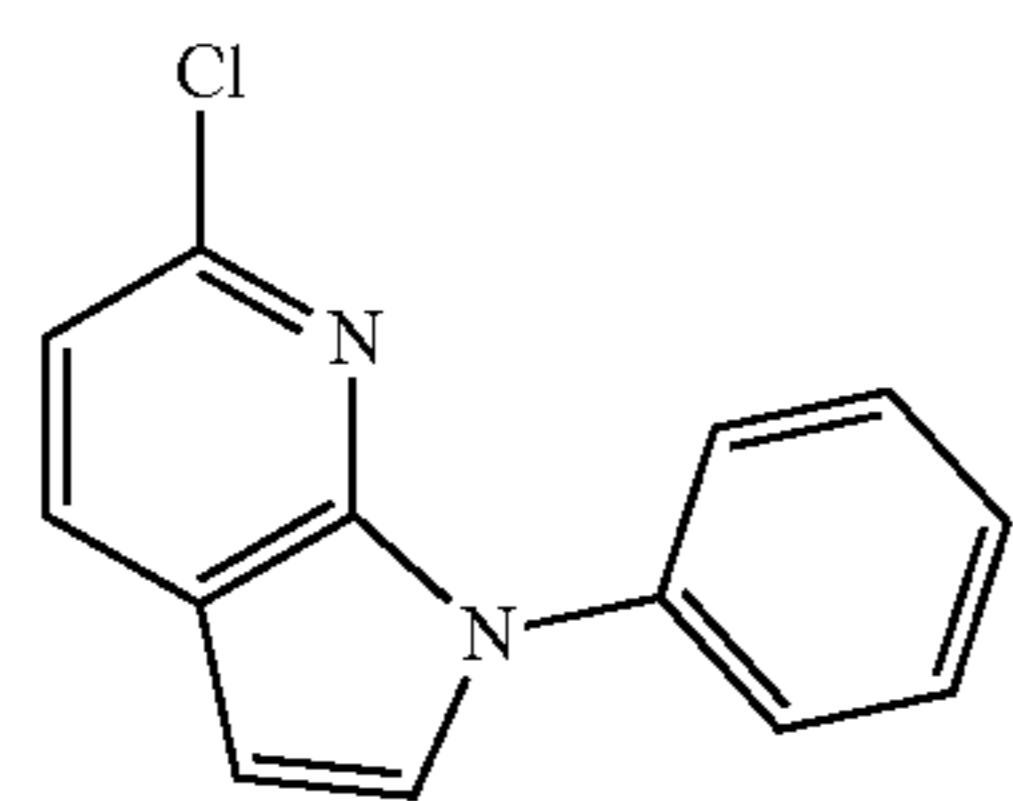
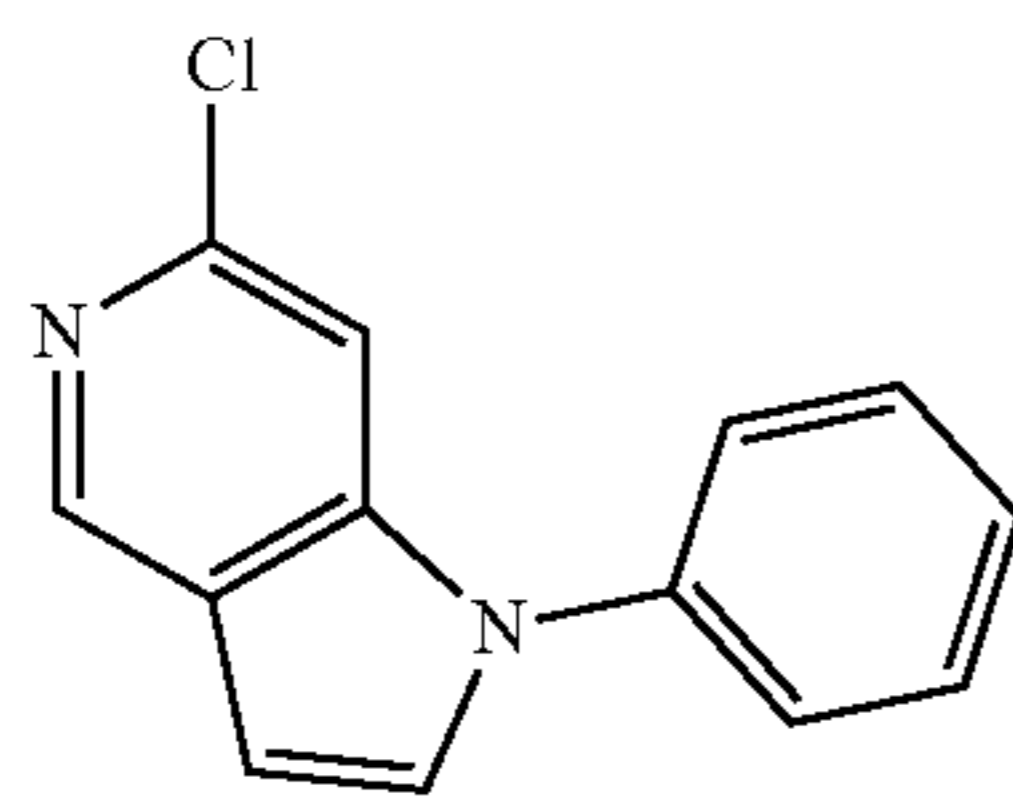
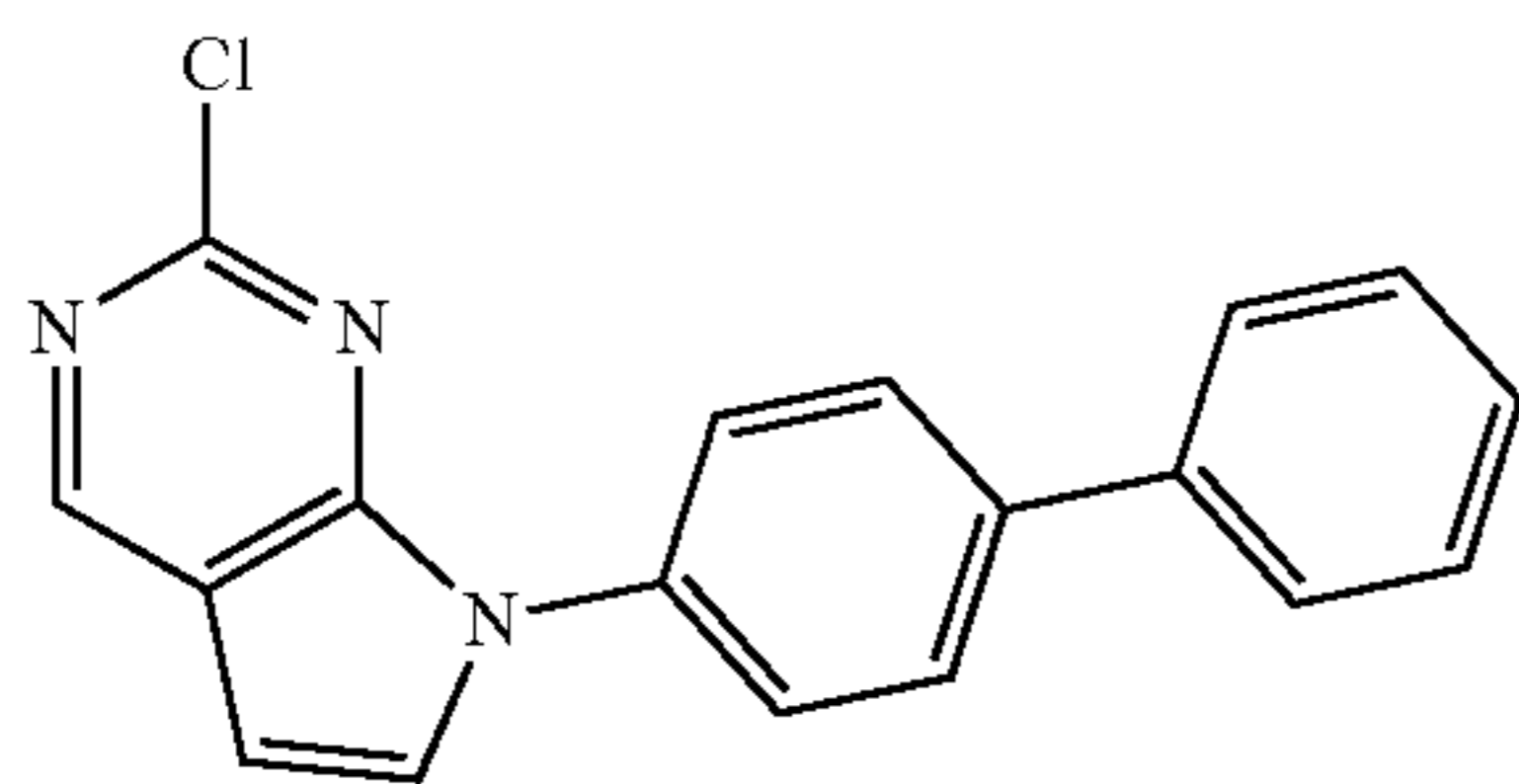
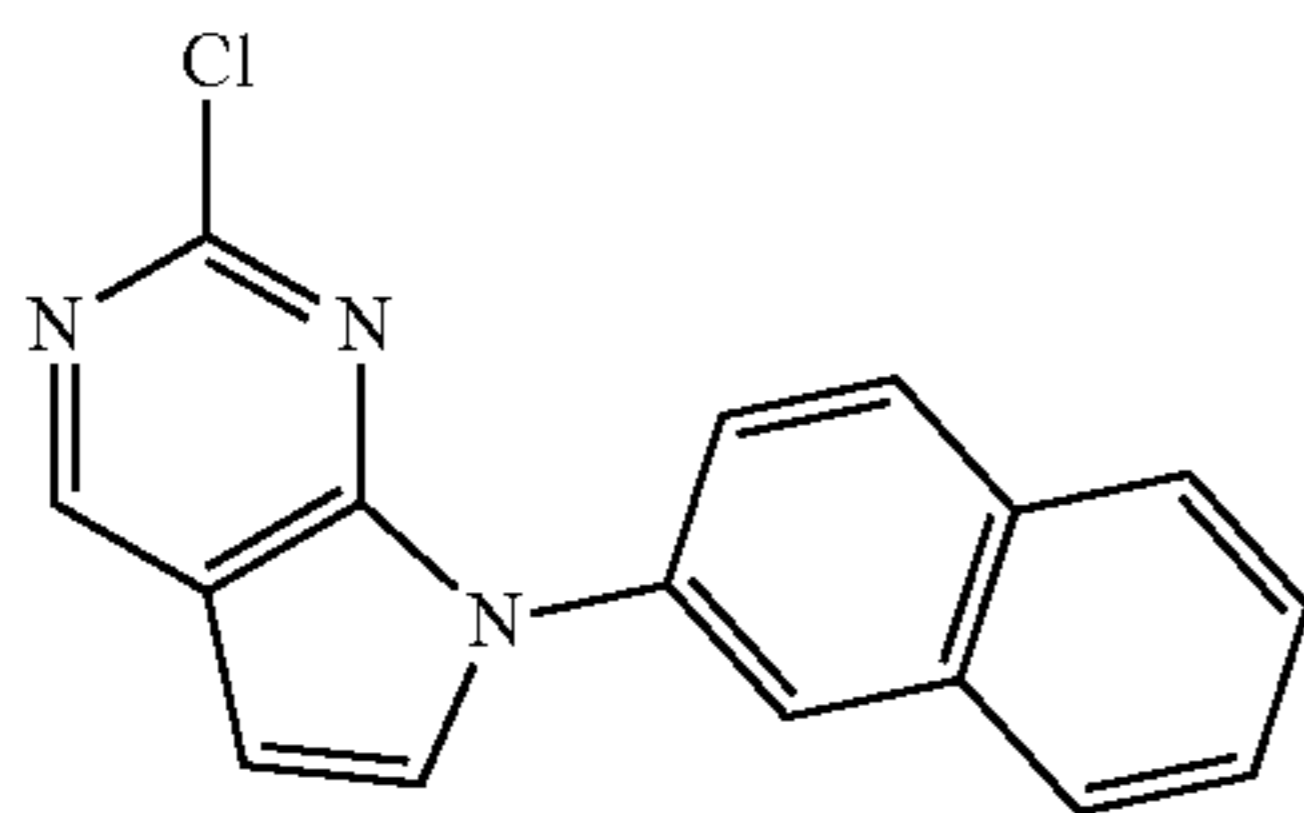
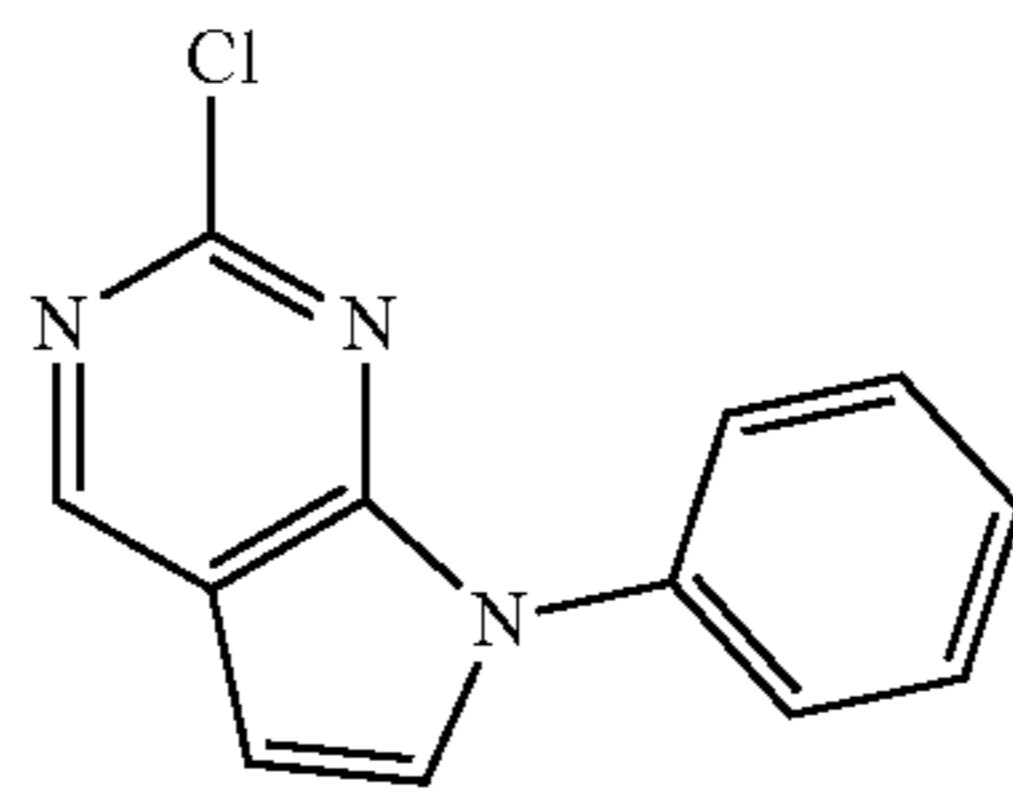
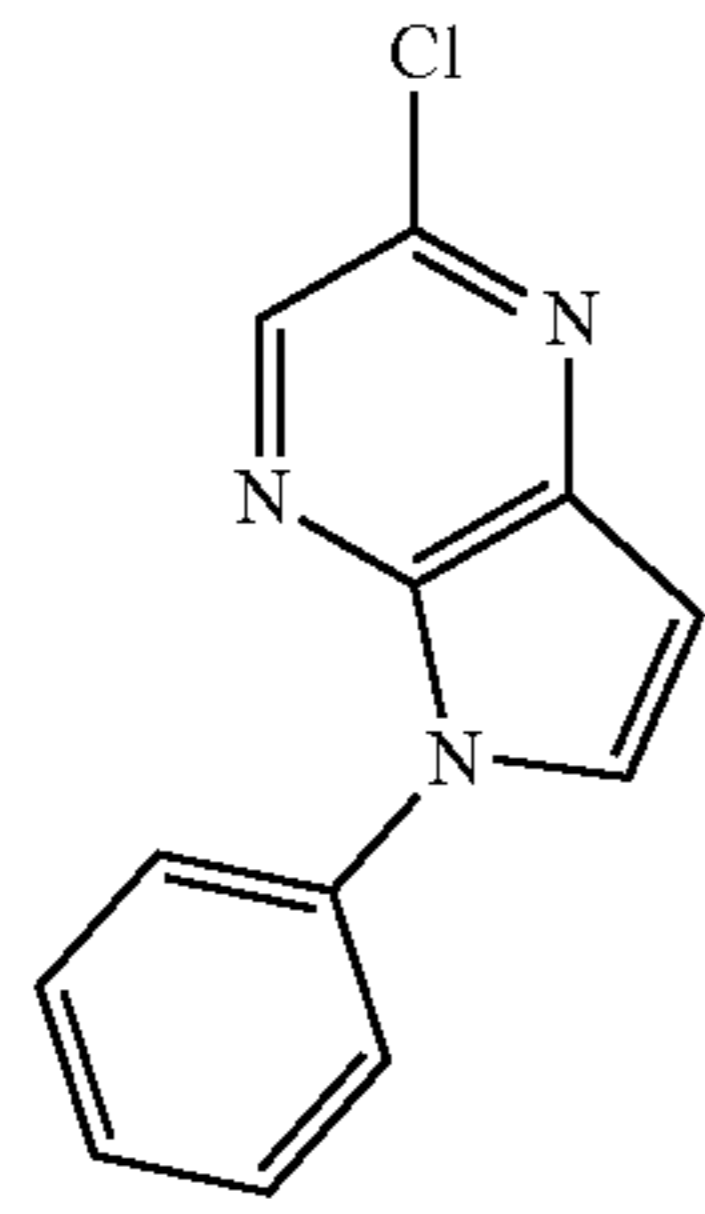
Sub 4-39

Sub 4-40

Sub 4-41

**147**

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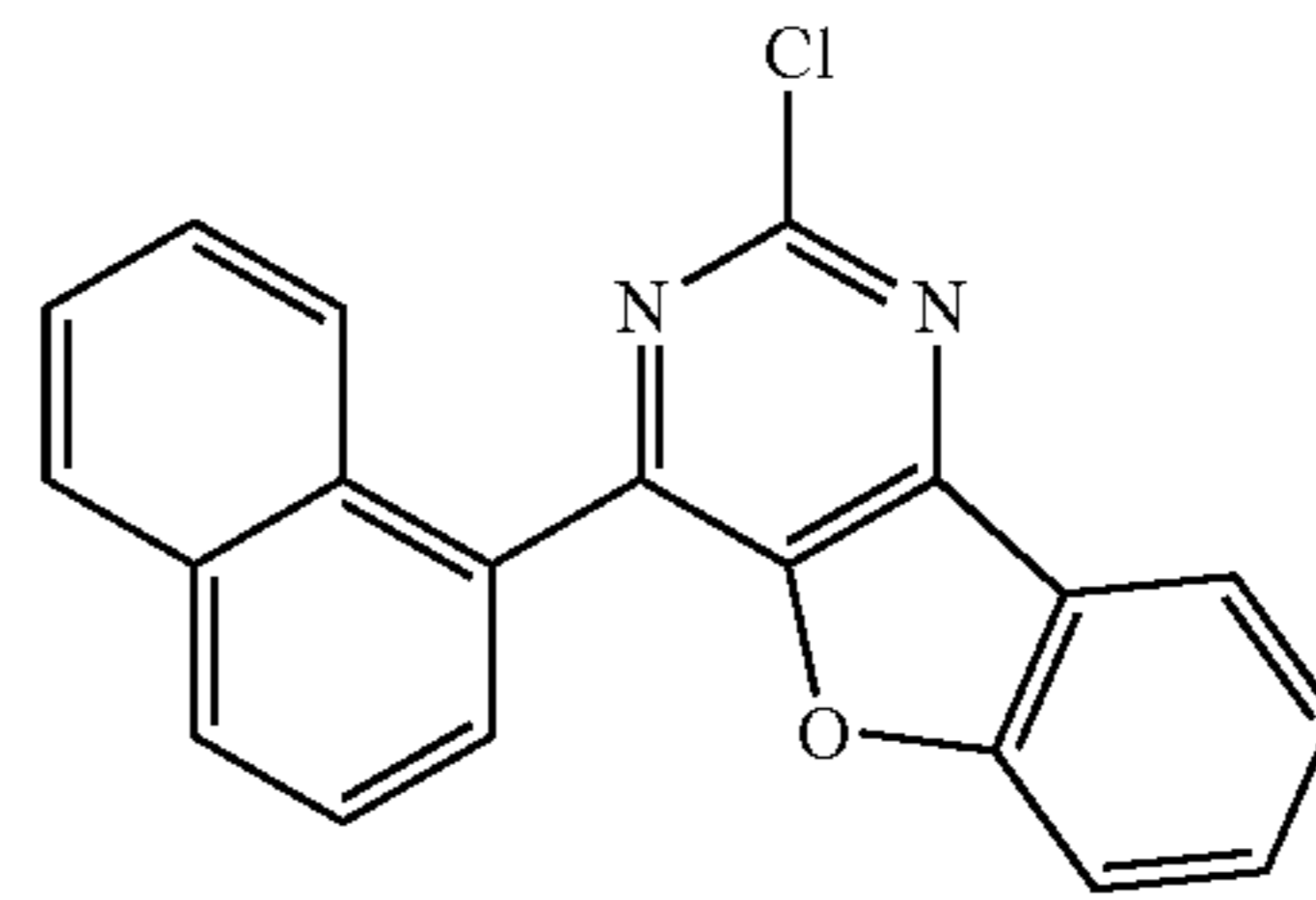


**148**

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Sub 4-42

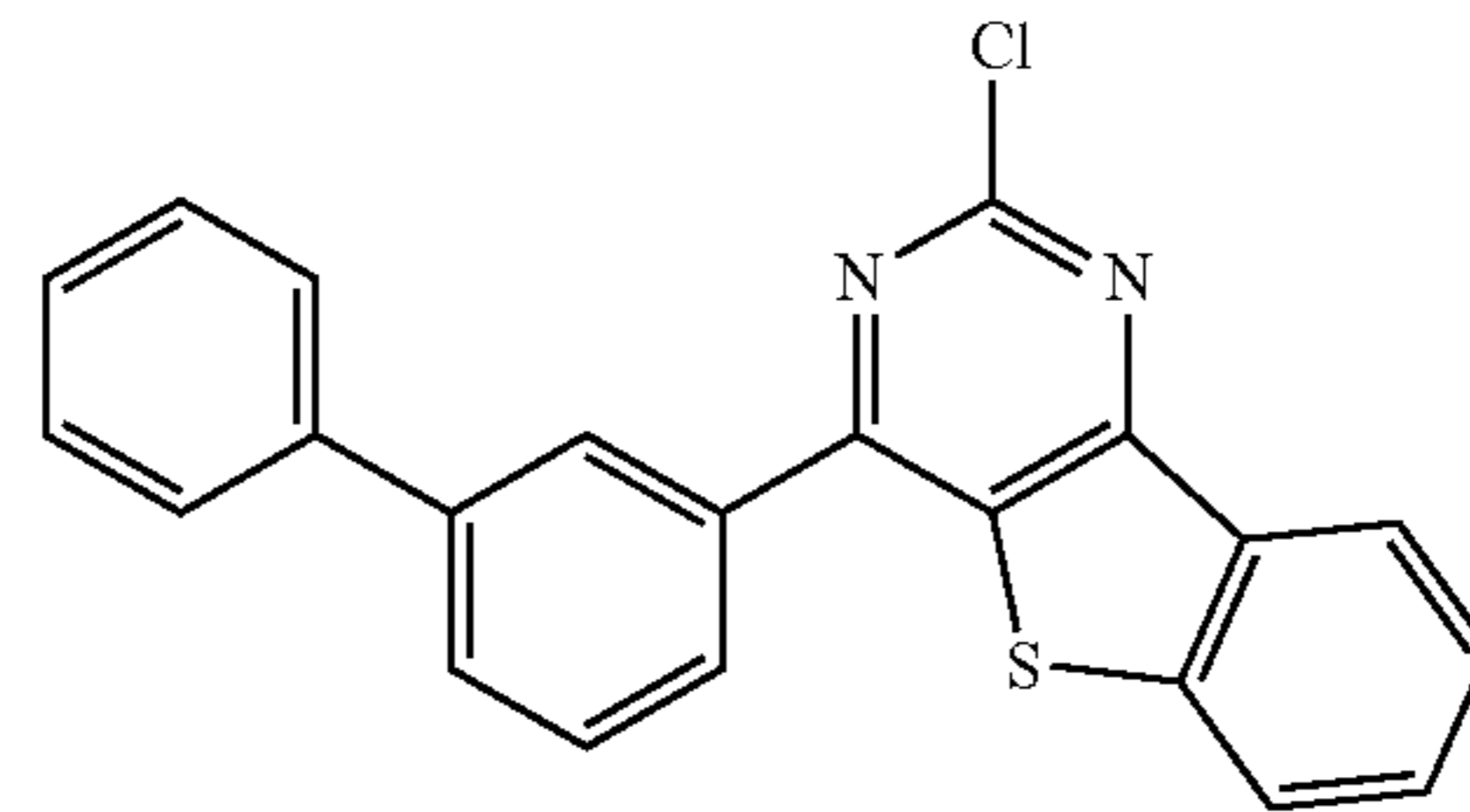
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Sub 4-43

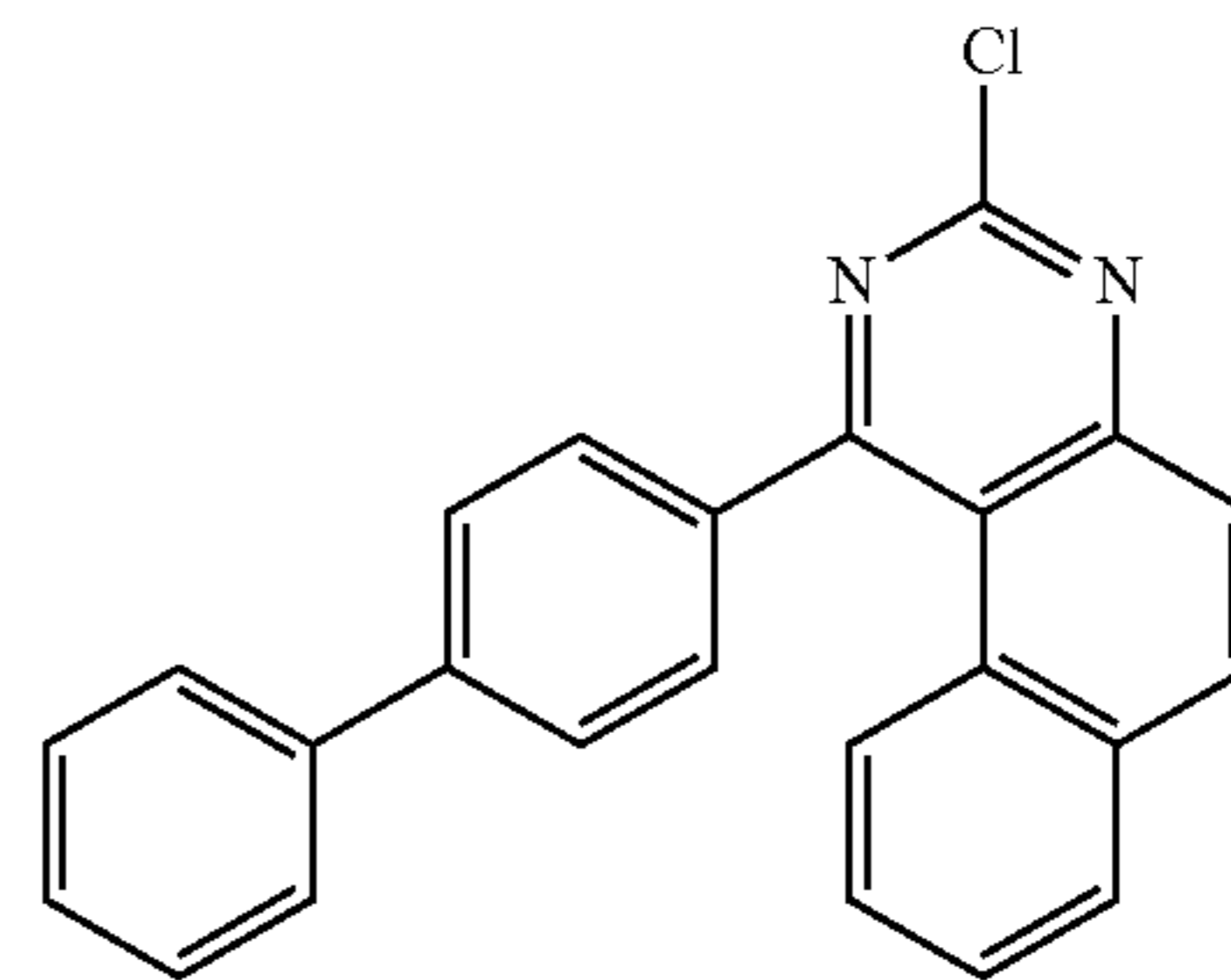
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Sub 4-44

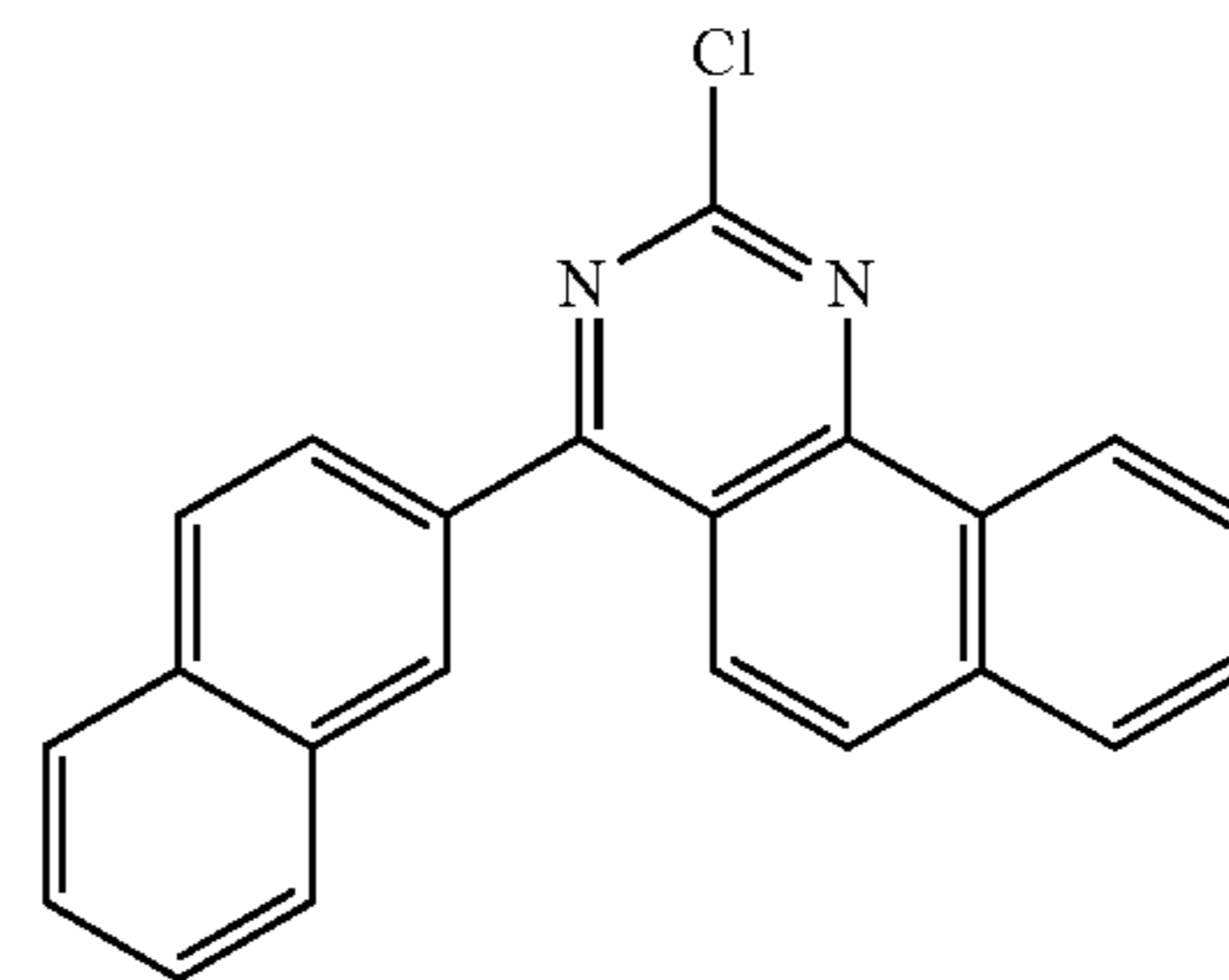
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Sub 4-45

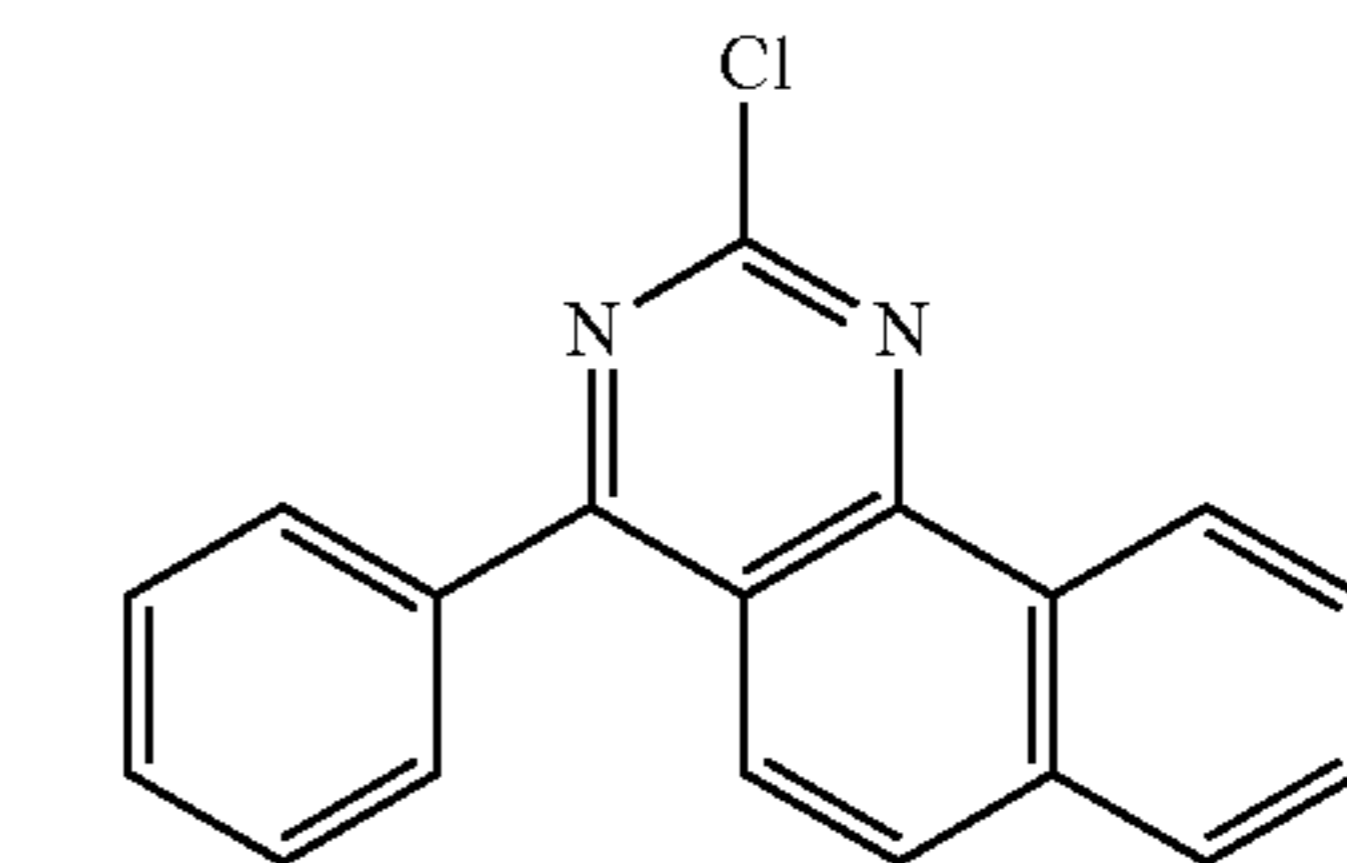
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Sub 4-46

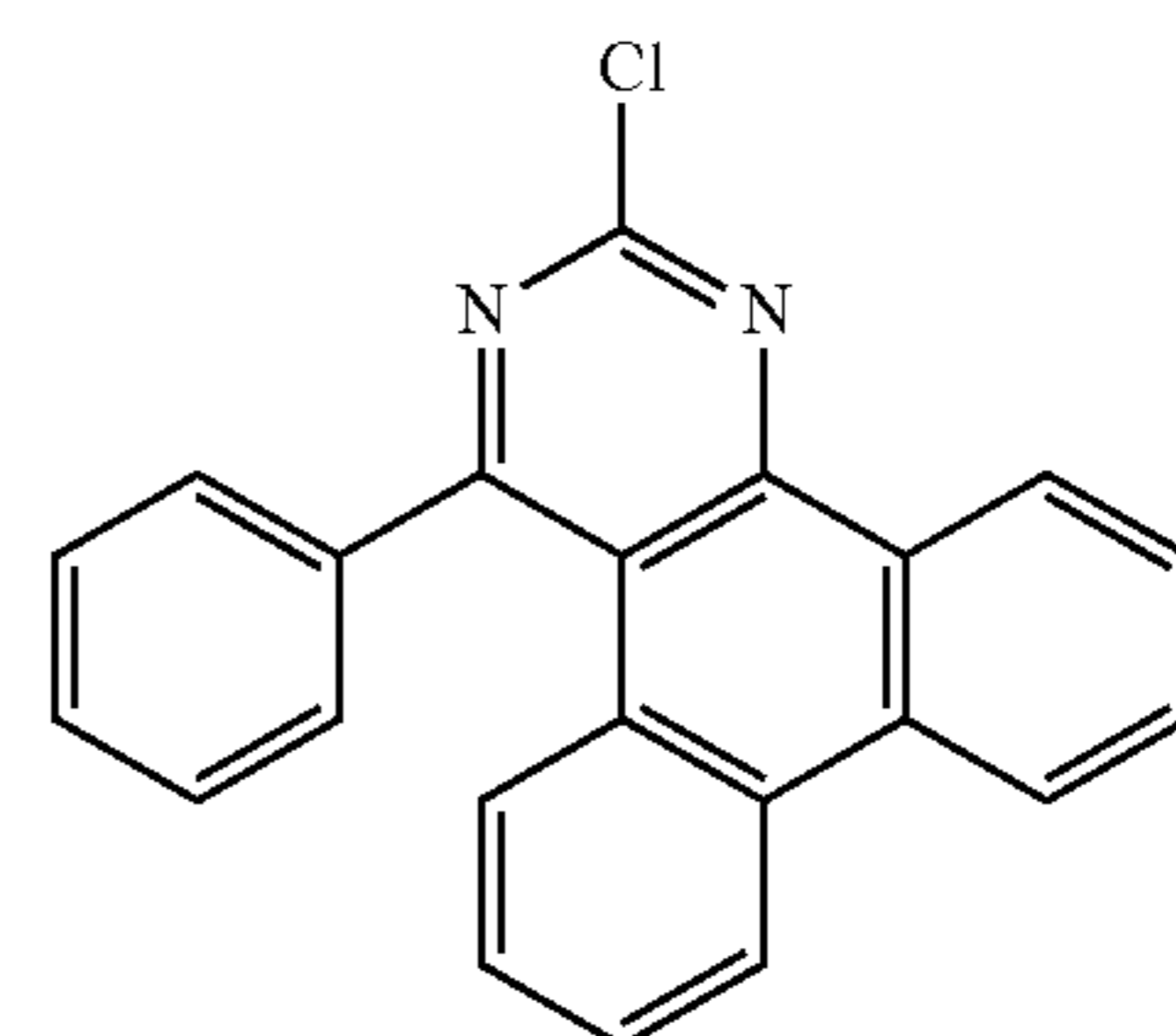
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Sub 4-47

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Sub 4-48

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Sub 4-49

Sub 4-50

Sub 4-51

Sub 4-52

Sub 4-53

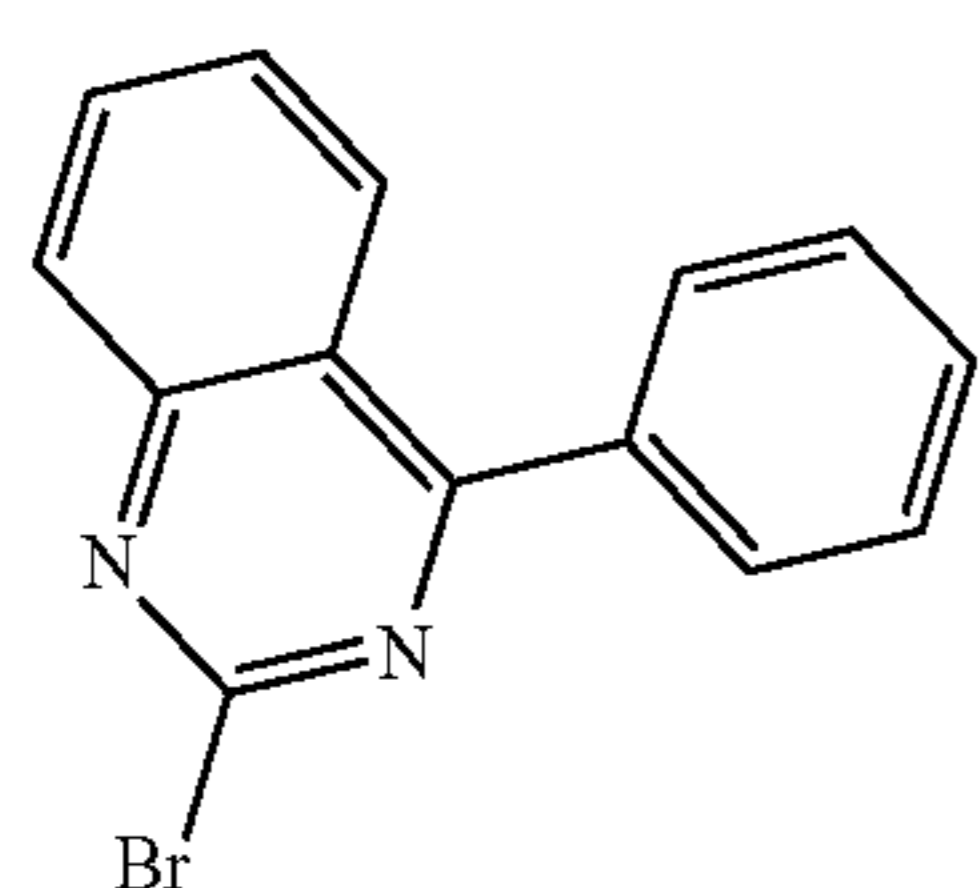
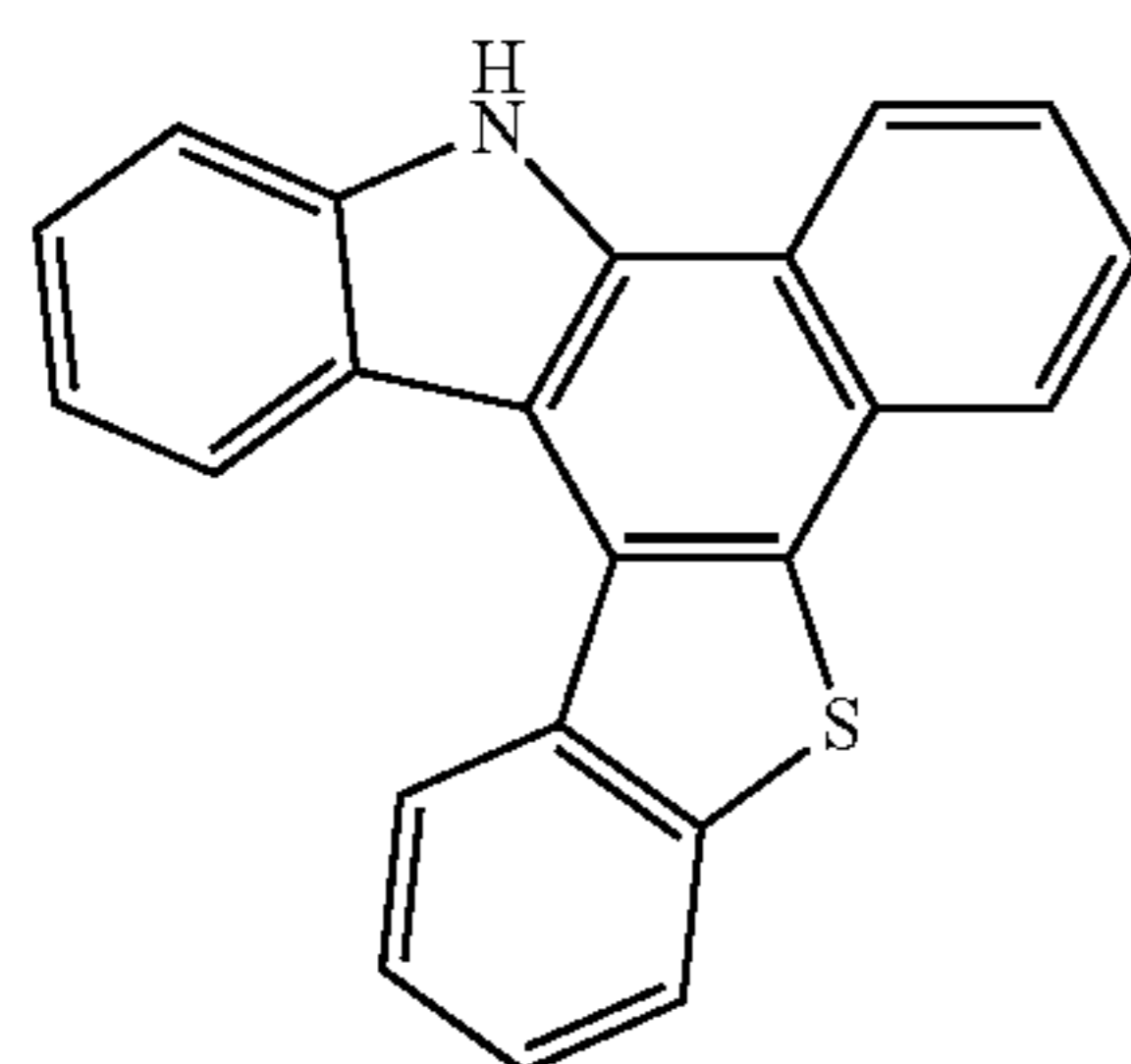
Sub 4-54

TABLE 4

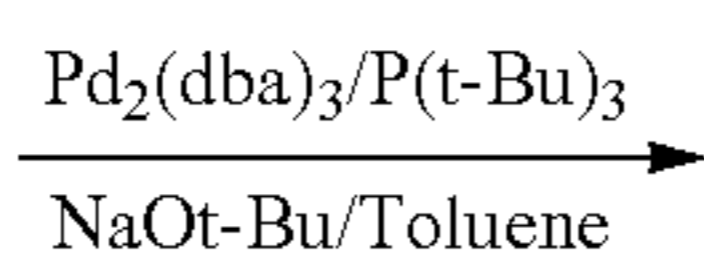
compound	FD-MS	compound	FD-MS
Sub 4-1	m/z = 155.96(C <sub>6</sub> H <sub>5</sub> Br = 157.01)	Sub 4-2	m/z = 205.97(C <sub>10</sub> H <sub>7</sub> Br = 207.07)
Sub 4-3	m/z = 205.97(C <sub>10</sub> H <sub>7</sub> Br = 207.07)	Sub 4-4	m/z = 231.99(C <sub>12</sub> H <sub>9</sub> Br = 233.10)
Sub 4-5	m/z = 309.02(C <sub>17</sub> H <sub>12</sub> BrN = 310.19)	Sub 4-6	m/z = 311.01(C <sub>15</sub> H <sub>10</sub> BrN <sub>3</sub> = 312.16)
Sub 4-7	m/z = 310.01(C <sub>16</sub> H <sub>11</sub> BrN <sub>2</sub> = 311.18)	Sub 4-8	m/z = 310.01(C <sub>16</sub> H <sub>11</sub> BrN <sub>2</sub> = 311.18)
Sub 4-9	m/z = 310.01(C <sub>16</sub> H <sub>11</sub> BrN <sub>2</sub> = 311.18)	Sub 4-10	m/z = 387.04(C <sub>21</sub> H <sub>14</sub> BrN <sub>3</sub> = 388.26)
Sub 4-11	m/z = 386.04(C <sub>22</sub> H <sub>15</sub> BrN <sub>2</sub> = 387.27)	Sub 4-12	m/z = 386.04(C <sub>22</sub> H <sub>15</sub> BrN <sub>2</sub> = 387.27)
Sub 4-13	m/z = 348.03(C <sub>19</sub> H <sub>13</sub> BrN <sub>2</sub> = 349.22)	Sub 4-14	m/z = 271.99(C <sub>13</sub> H <sub>9</sub> BrN <sub>2</sub> = 273.13)
Sub 4-15	m/z = 283.99(C <sub>14</sub> H <sub>9</sub> BrN <sub>2</sub> = 285.14)	Sub 4-16	m/z = 374.01(C <sub>20</sub> H <sub>11</sub> BrN <sub>2</sub> O = 375.22)
Sub 4-17	m/z = 400.06(C <sub>23</sub> H <sub>17</sub> BrN <sub>2</sub> = 401.30)	Sub 4-18	m/z = 360.03(C <sub>20</sub> H <sub>13</sub> BrN <sub>2</sub> = 361.23)
Sub 4-19	m/z = 476.09(C <sub>29</sub> H <sub>21</sub> BrN <sub>2</sub> = 477.39)	Sub 4-20	m/z = 284.99(C <sub>13</sub> H <sub>8</sub> BrN <sub>3</sub> = 286.13)
Sub 4-21	m/z = 289.03(C <sub>14</sub> H <sub>4</sub> D <sub>5</sub> BrN <sub>2</sub> = 290.2)	Sub 4-22	m/z = 284.99(C <sub>13</sub> H <sub>8</sub> BrN <sub>3</sub> = 286.13)
Sub 4-23	m/z = 375.00(C <sub>19</sub> H <sub>10</sub> BrN <sub>3</sub> O = 376.2)	Sub 4-24	m/z = 401.05(C <sub>22</sub> H <sub>16</sub> BrN <sub>3</sub> = 402.29)
Sub 4-25	m/z = 296.02(C <sub>16</sub> H <sub>9</sub> ClN <sub>2</sub> S = 296.77)	Sub 4-26	m/z = 322.03(C <sub>18</sub> H <sub>11</sub> ClN <sub>2</sub> S = 322.81)
Sub 4-27	m/z = 322.03(C <sub>18</sub> H <sub>11</sub> ClN <sub>2</sub> S = 322.81)	Sub 4-28	m/z = 168.98(C <sub>7</sub> H <sub>4</sub> ClNS = 169.63)
Sub 4-29	m/z = 168.98(C <sub>7</sub> H <sub>4</sub> ClNS = 169.63)	Sub 4-30	m/z = 169.97(C <sub>6</sub> H <sub>3</sub> ClN <sub>2</sub> S = 170.62)
Sub 4-31	m/z = 246.00(C <sub>12</sub> H <sub>7</sub> ClN <sub>2</sub> S = 246.72)	Sub 4-32	m/z = 322.03(C <sub>18</sub> H <sub>11</sub> ClN <sub>2</sub> S = 322.81)
Sub 4-33	m/z = 322.03(C <sub>18</sub> H <sub>11</sub> ClN <sub>2</sub> S = 322.81)	Sub 4-34	m/z = 168.98(C <sub>7</sub> H <sub>4</sub> ClNS = 169.63)
Sub 4-35	m/z = 168.98(C <sub>7</sub> H <sub>4</sub> ClNS = 169.63)	Sub 4-36	m/z = 169.97(C <sub>6</sub> H <sub>3</sub> ClN <sub>2</sub> S = 170.62)
Sub 4-37	m/z = 229.04(C <sub>12</sub> H <sub>8</sub> ClN <sub>3</sub> = 229.67)	Sub 4-38	m/z = 279.06(C <sub>16</sub> H <sub>10</sub> ClN <sub>3</sub> = 279.72)
Sub 4-39	m/z = 305.07(C <sub>18</sub> H <sub>12</sub> ClN <sub>3</sub> = 305.76)	Sub 4-40	m/z = 228.05(C <sub>13</sub> H <sub>9</sub> ClN <sub>2</sub> = 228.68)
Sub 4-41	m/z = 228.05(C <sub>13</sub> H <sub>9</sub> ClN <sub>2</sub> = 228.68)	Sub 4-42	m/z = 229.04(C <sub>12</sub> H <sub>8</sub> ClN <sub>3</sub> = 229.67)
Sub 4-43	m/z = 229.04(C <sub>12</sub> H <sub>8</sub> ClN <sub>3</sub> = 229.67)	Sub 4-44	m/z = 279.06(C <sub>16</sub> H <sub>10</sub> ClN <sub>3</sub> = 279.72)
Sub 4-45	m/z = 305.07(C <sub>18</sub> H <sub>12</sub> ClN <sub>3</sub> = 305.76)	Sub 4-46	m/z = 228.05(C <sub>13</sub> H <sub>9</sub> ClN <sub>2</sub> = 228.68)
Sub 4-47	m/z = 228.05(C <sub>13</sub> H <sub>9</sub> ClN <sub>2</sub> = 228.68)	Sub 4-48	m/z = 229.04(C <sub>12</sub> H <sub>8</sub> ClN <sub>3</sub> = 229.67)
Sub 4-49	m/z = 330.1(C <sub>20</sub> H <sub>11</sub> ClN <sub>2</sub> O = 330.77)	Sub 4-50	m/z = 372.05(C <sub>22</sub> H <sub>13</sub> ClN <sub>2</sub> S = 372.87)
Sub 4-51	m/z = 366.09(C <sub>24</sub> H <sub>15</sub> ClN <sub>2</sub> = 366.85)	Sub 4-52	m/z = 340.08(C <sub>22</sub> H <sub>13</sub> ClN <sub>2</sub> = 340.81)
Sub 4-53	m/z = 290.06(C <sub>18</sub> H <sub>11</sub> ClN <sub>2</sub> = 290.75)	Sub 4-54	m/z = 340.08(C <sub>22</sub> H <sub>13</sub> ClN <sub>2</sub> = 340.81)

## Synthesis of Final Product 2

## Synthesis Example of 3-6



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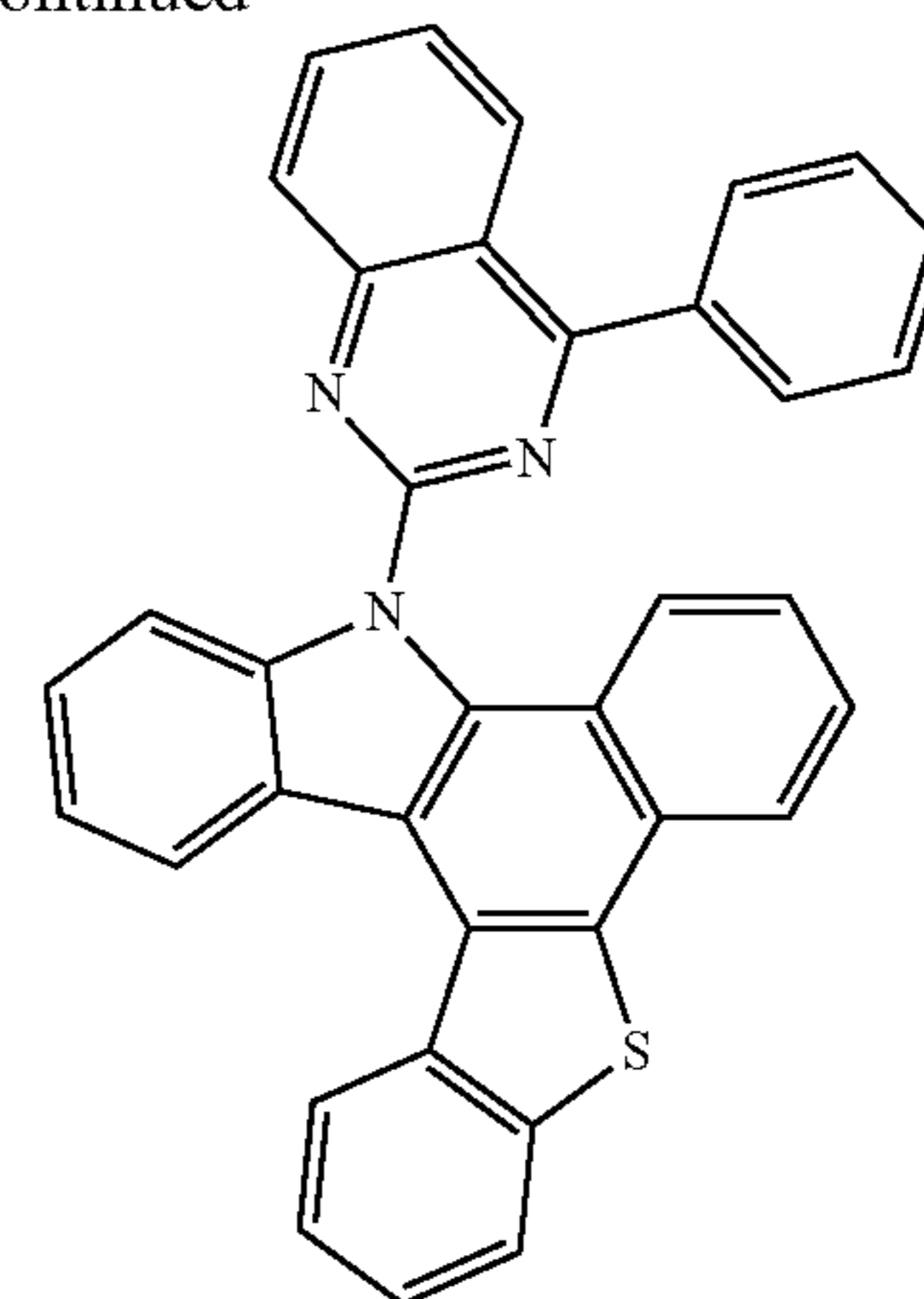
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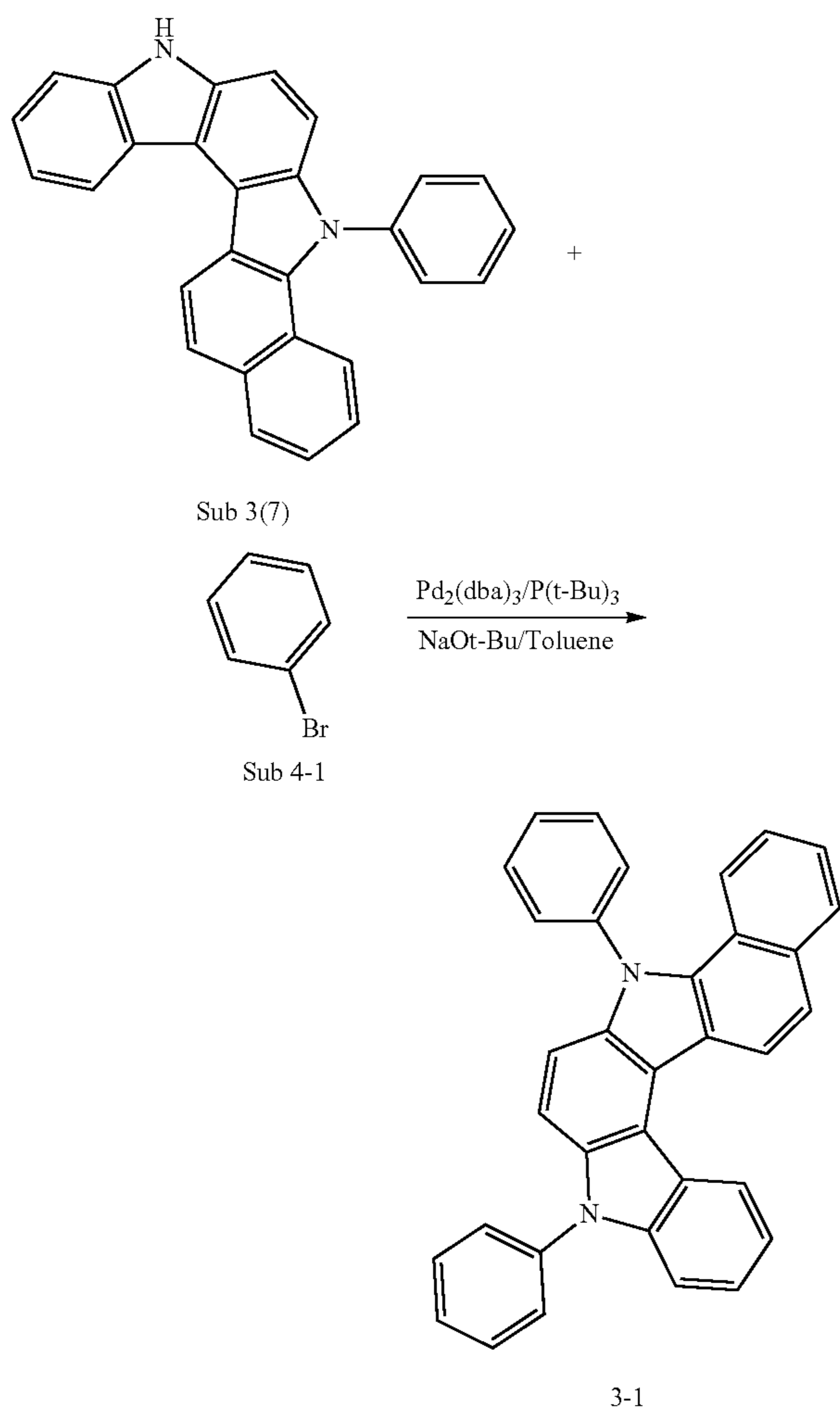
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After Sub 3(1) (15.3 g, 47.3 mmol) was placed in a round bottom flask and dissolved in toluene (500 mL), and Sub 4-15 (14.8 g, 52.0 mmol), Pd<sub>2</sub>(dba)<sub>3</sub> (2.4 g, 2.6 mmol), P(t-Bu)<sub>3</sub> (1.1 g, 5.2 mmol), NaOt-Bu (15 g, 156.1 mmol) were added and refluxed at 100° C. After the reaction was completed, the reaction mixture was extracted with CH<sub>2</sub>Cl<sub>2</sub> and water. The organic layer was dried over MgSO<sub>4</sub> and concentrated. The resulting compound was separated by silicagel column chromatography and recrystallized to obtain 18.5 g of Product. (Yield: 74%)

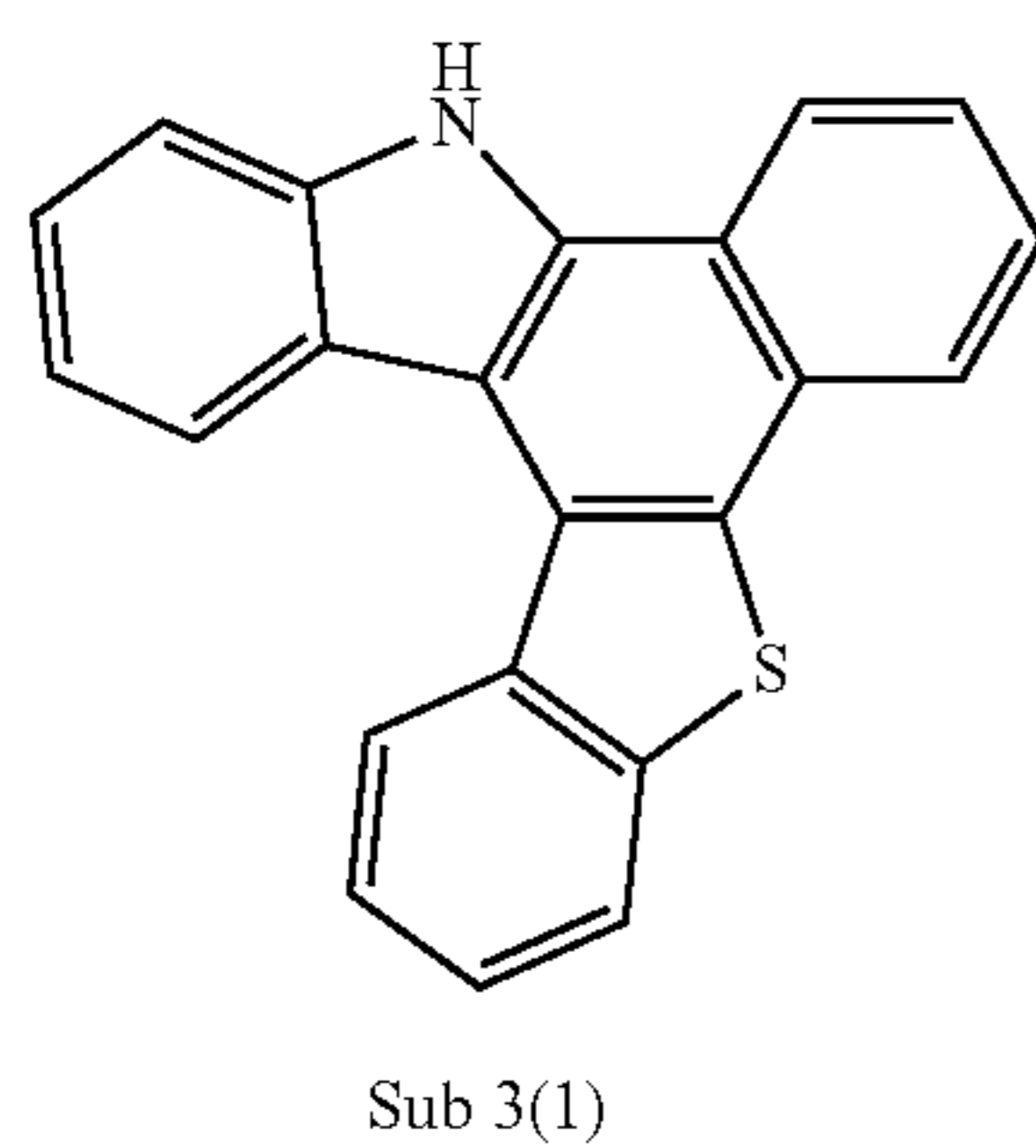
## 151

## Synthesis Example of 3-1



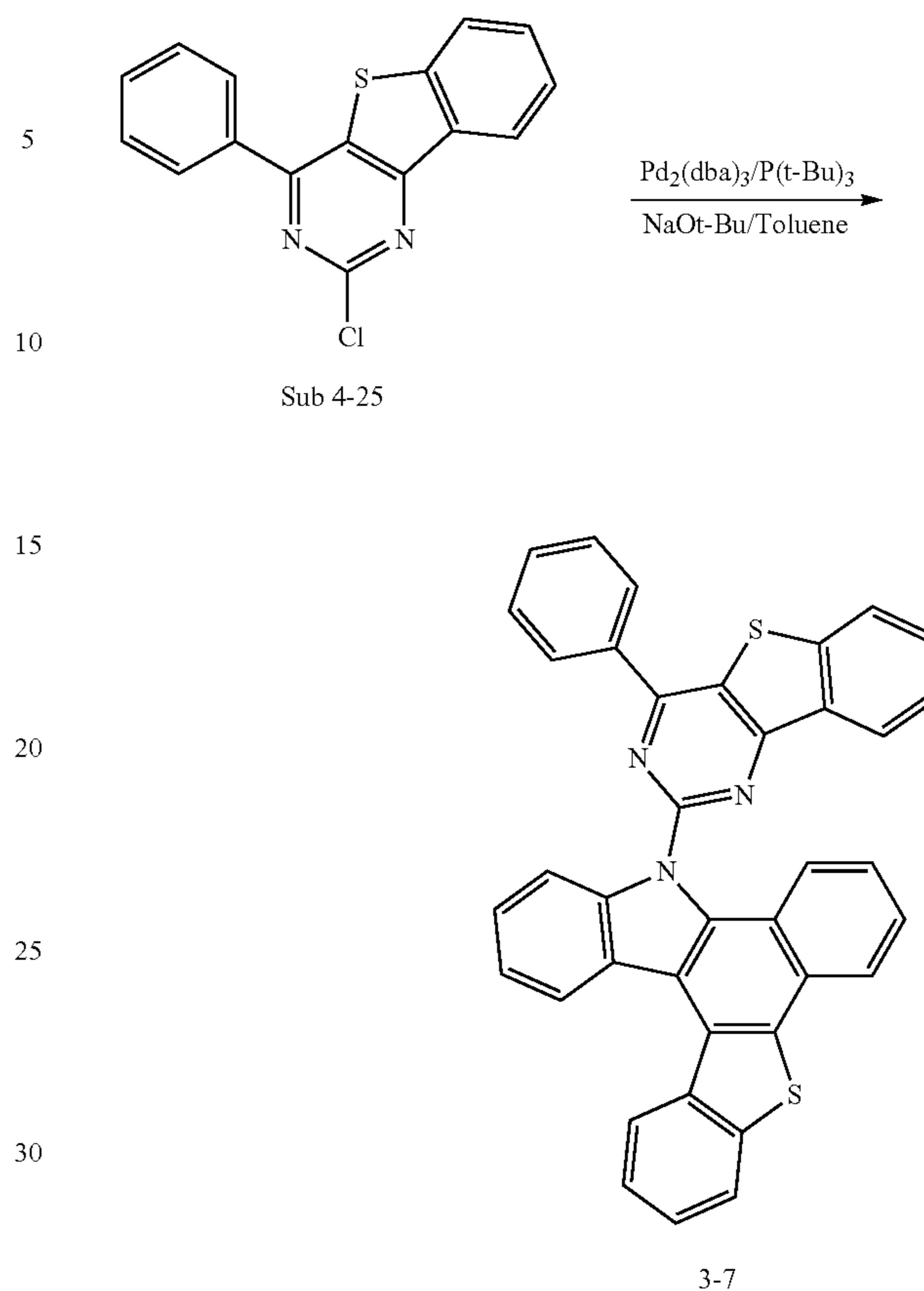
Sub 3(7) (18.1 g, 47.3 mmol), toluene (500 mL), Sub 4-1 (8.2 g, 52.0 mmol),  $\text{Pd}_2(\text{dba})_3$  (2.0 g, 2.2 mmol),  $\text{P}(\text{t-Bu})_3$  (0.9 g, 4.4 mmol), NaOt-Bu (12.7 g, 132 mmol) were added, the same procedure as described in the synthesis method of 3-6 was carried out to obtain 16.9 g of the final product. (Yield: 78%).

## Synthesis Example of 3-7



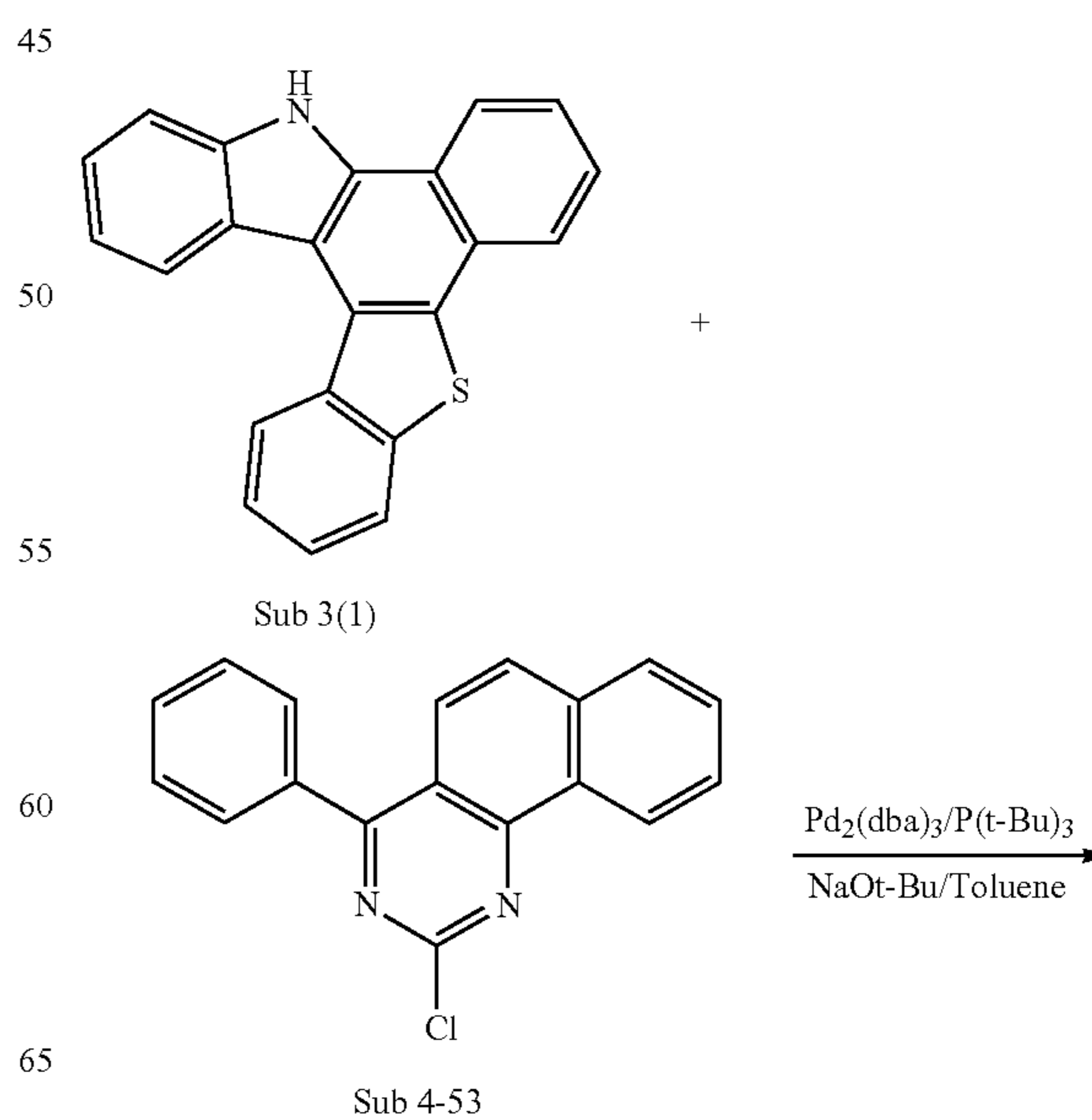
## 152

## -continued



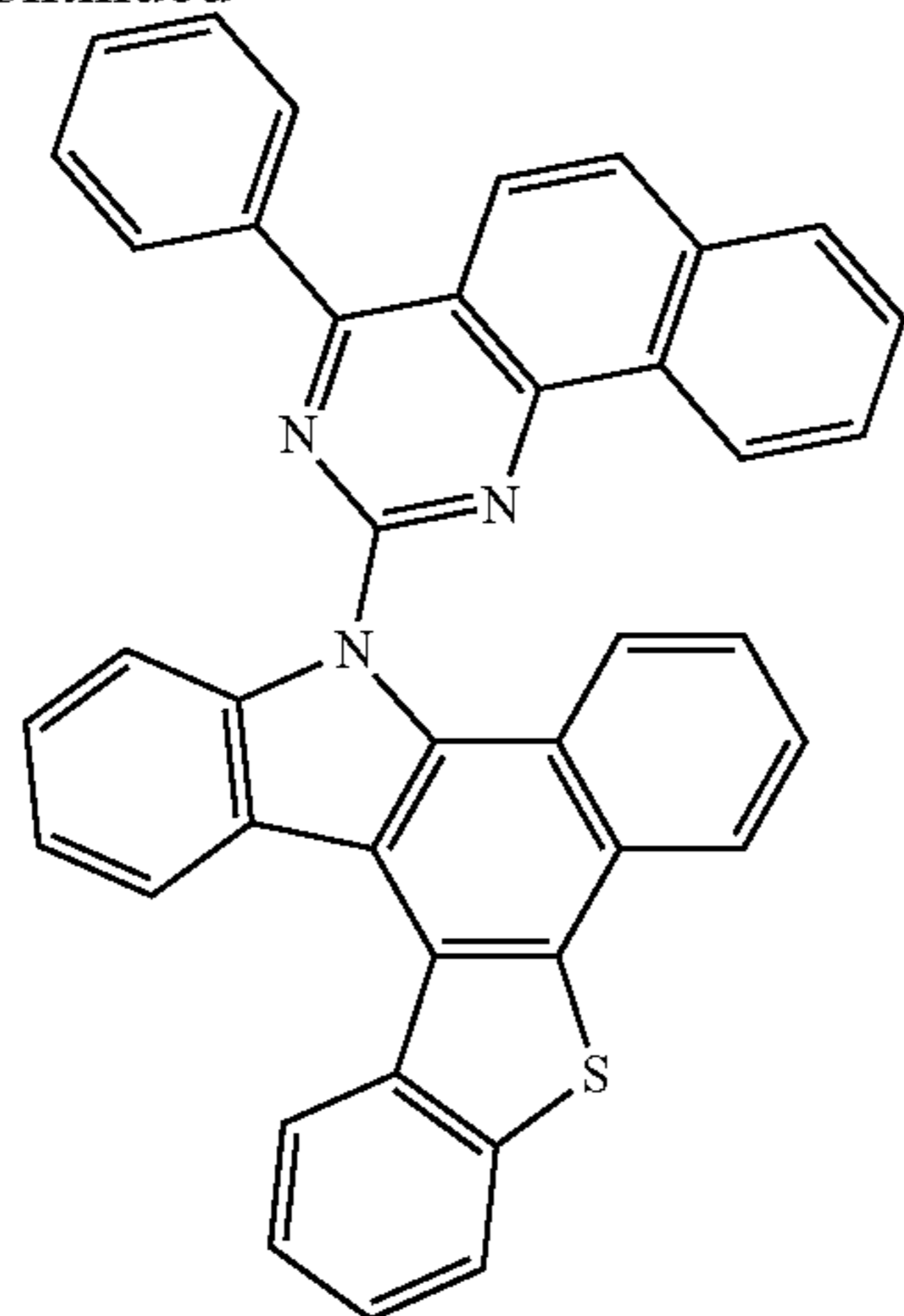
Sub 3(1) (15.3 g, 47.3 mmol), Sub 4-25 (15.4 g, 52.0 mmol) were added, the same procedure as described in the synthesis method of 3-6 was carried out to obtain 20.4 g of the final product. (Yield: 74%).

## Synthesis Example of 3-8



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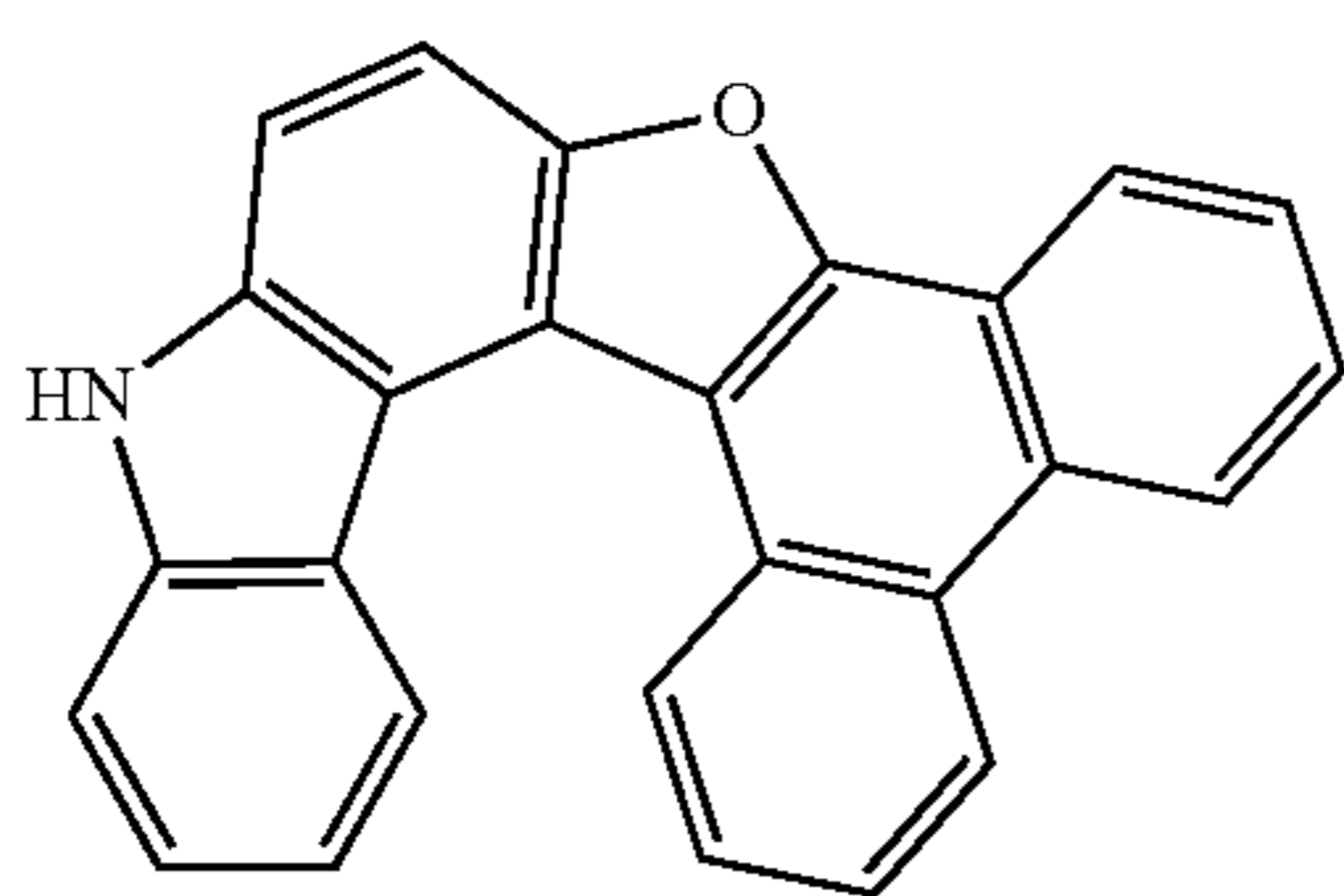
-continued



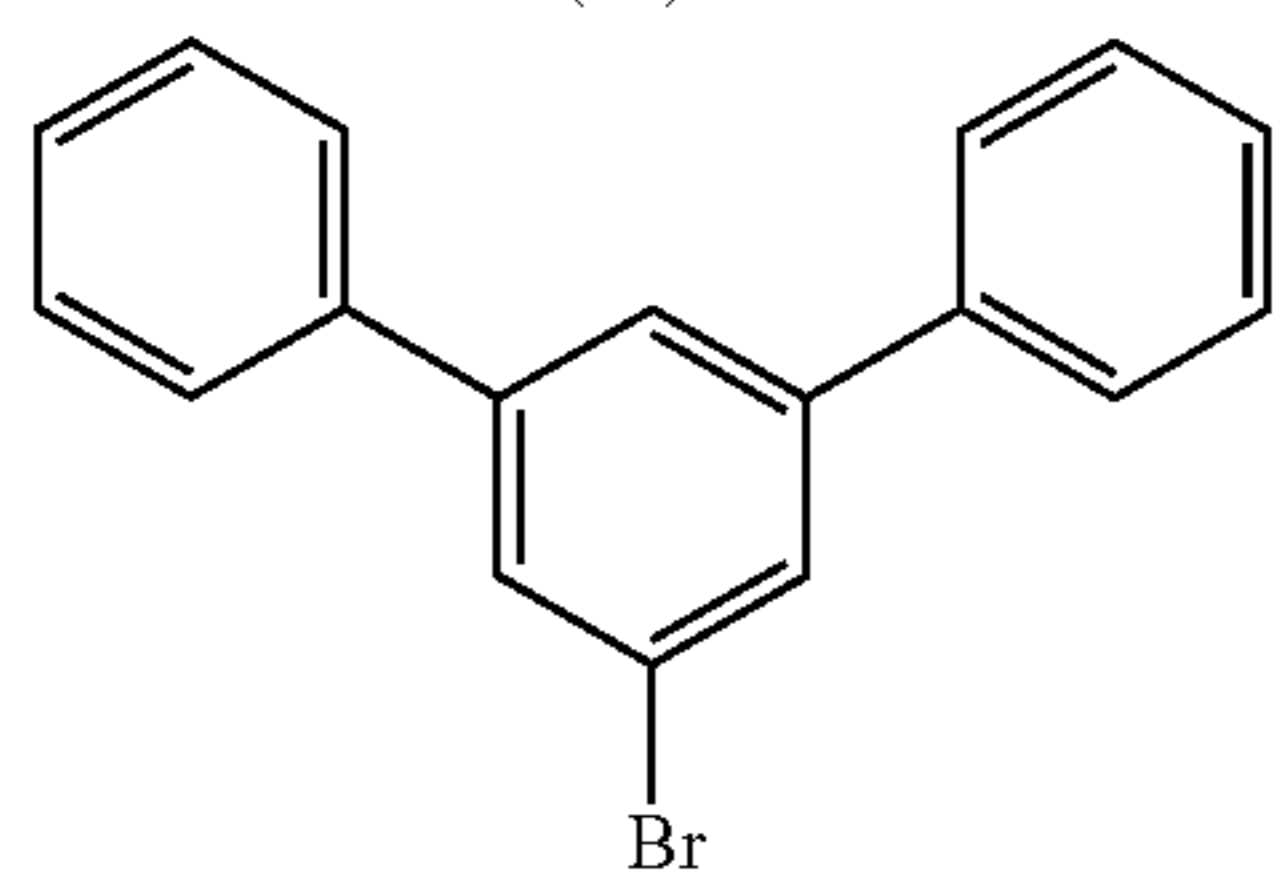
3-8

Sub 3(1) (15.3 g, 47.3 mmol), Sub 4-53 (15.1 g, 52.0 mmol) were added, the same procedure as described in the synthesis method of 3-6 was carried out to obtain 19.7 g of the final product. (Yield: 72%).

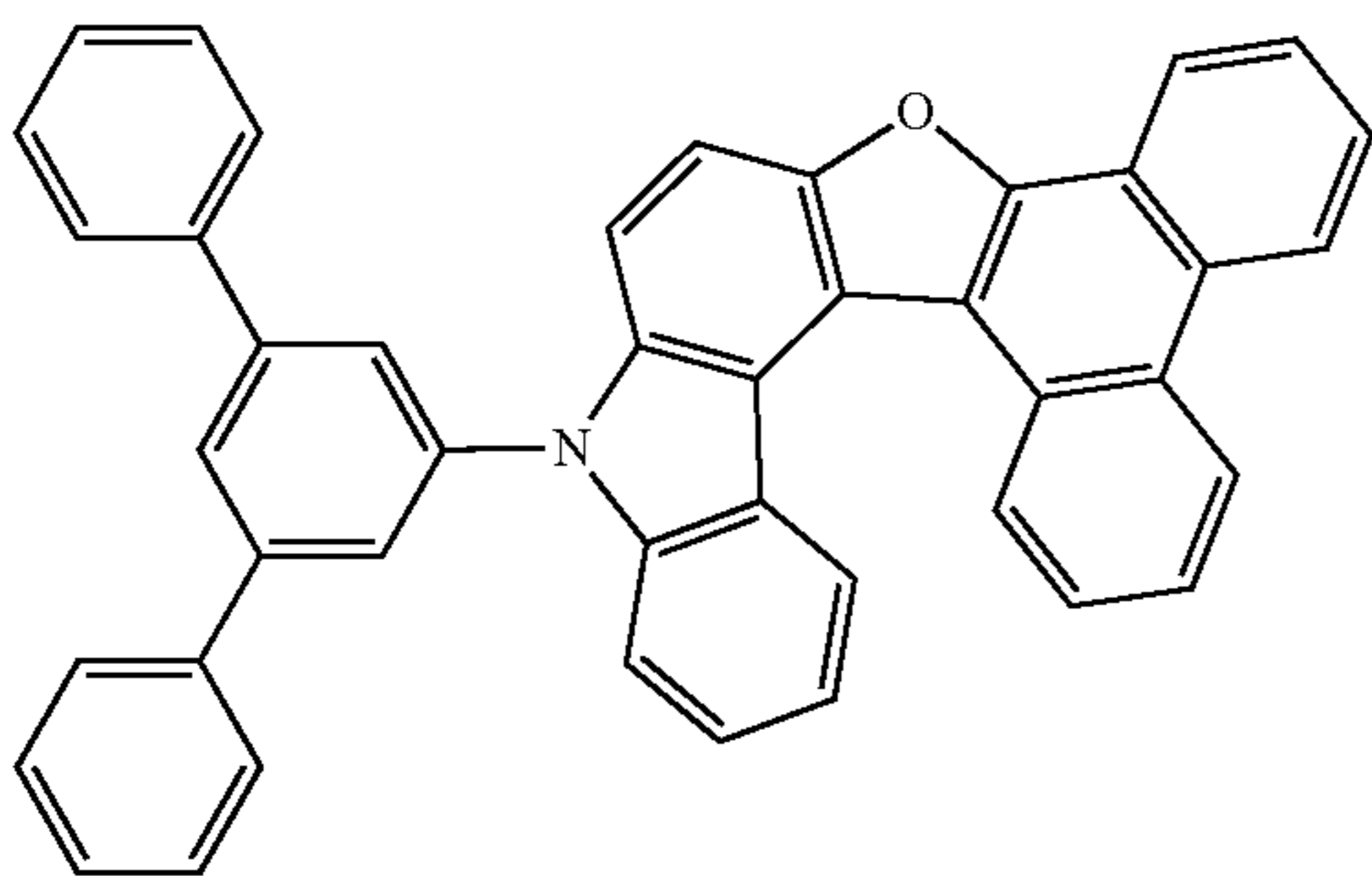
## Synthesis Example of 3-11



Sub 3-(13)



Sub 4-55



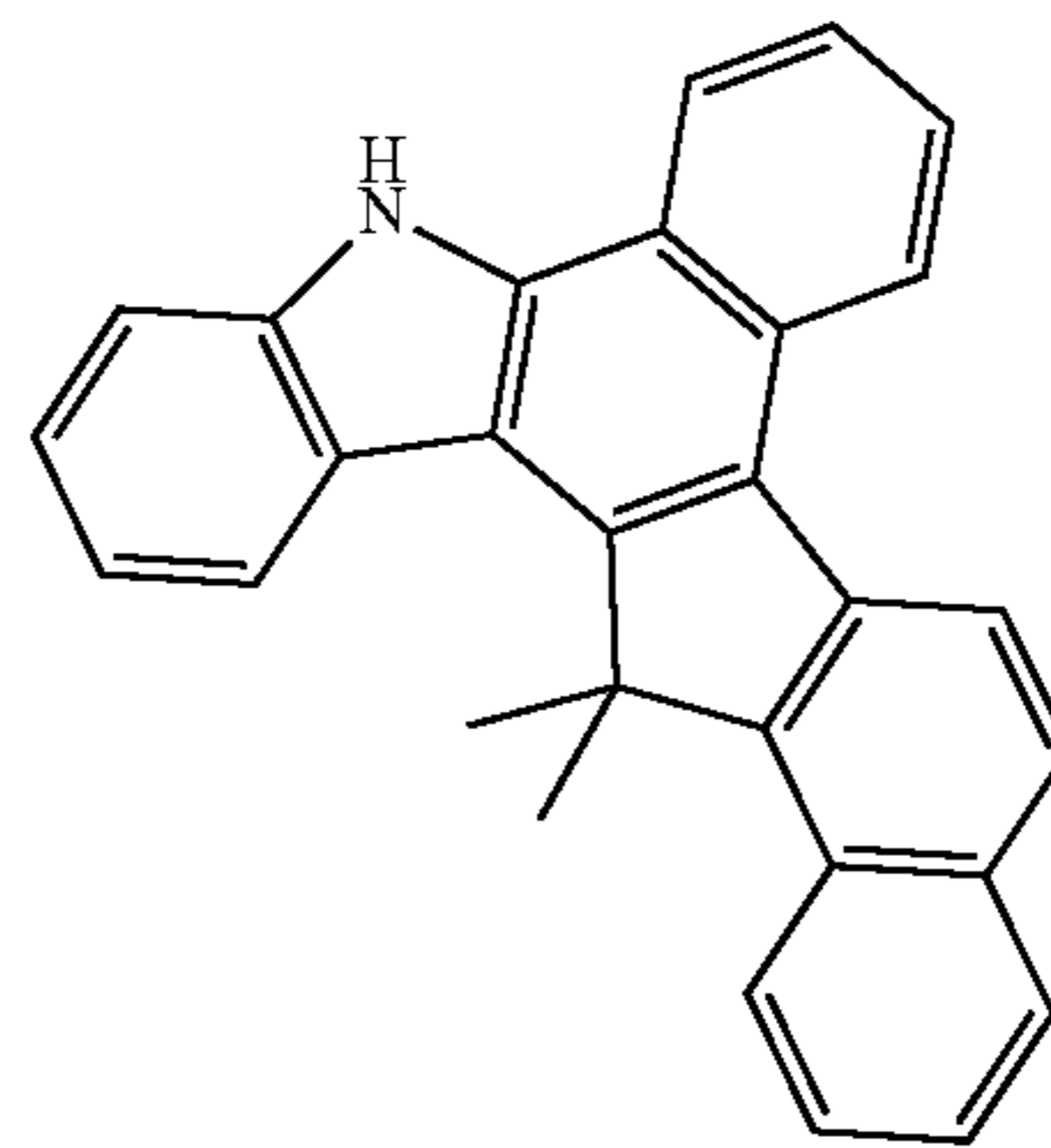
3-11

Sub 3(13) (16.9 g, 47.3 mmol), Sub 4-55 (16.1 g, 52.0 mmol) were added, the same procedure as described in the

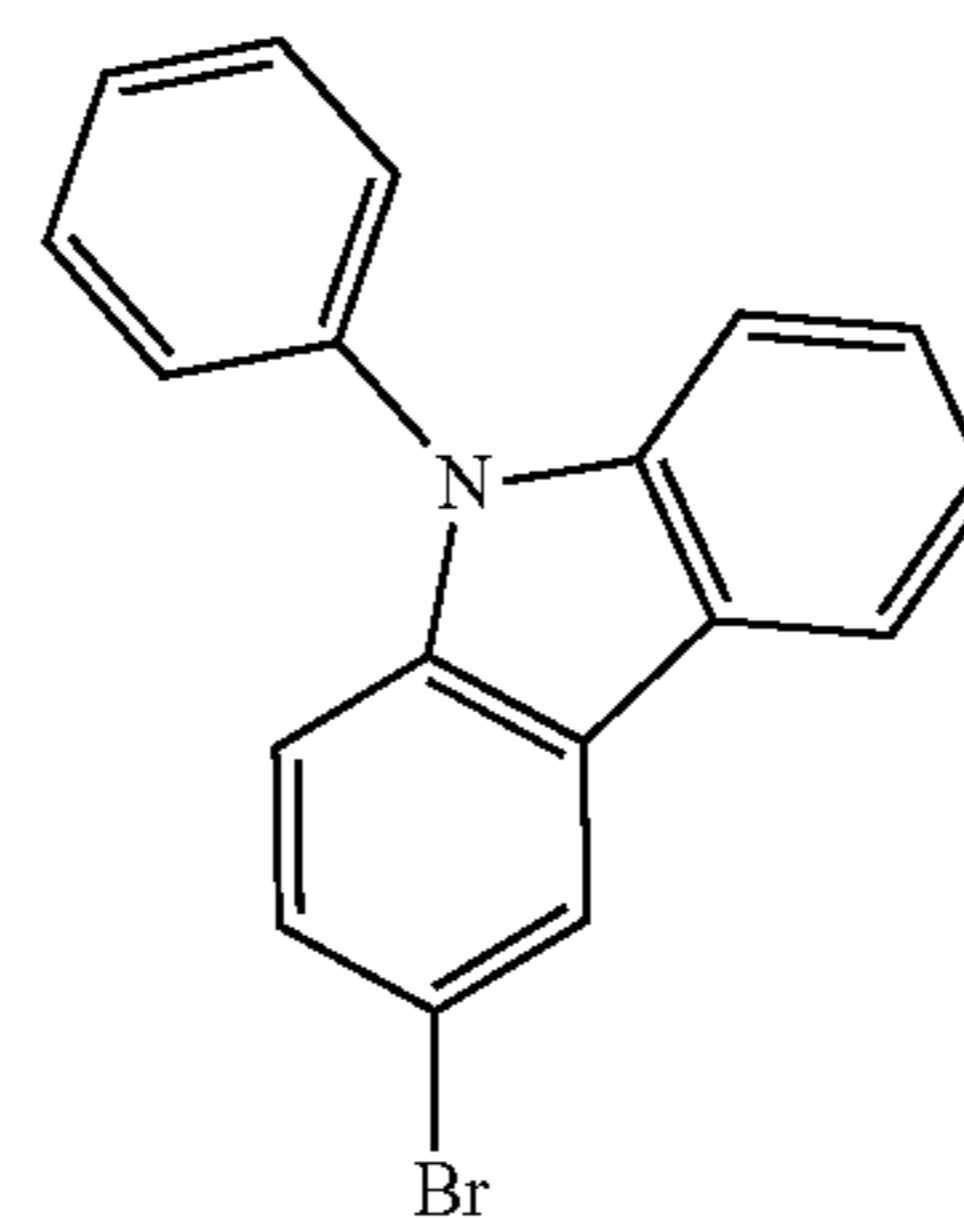
**154**

synthesis method of 3-6 was carried out to obtain 19.7 g of the final product. (Yield: 71%).

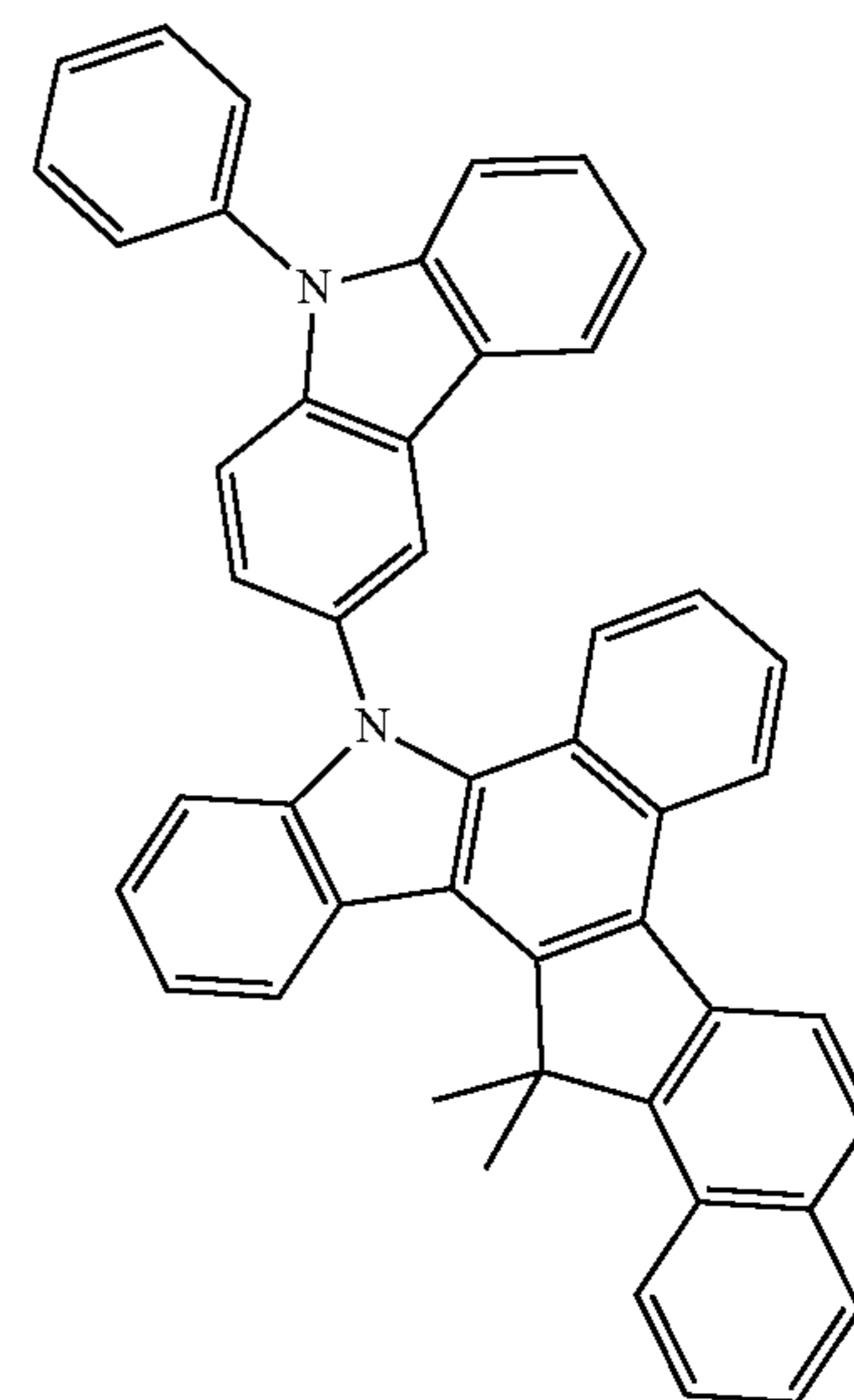
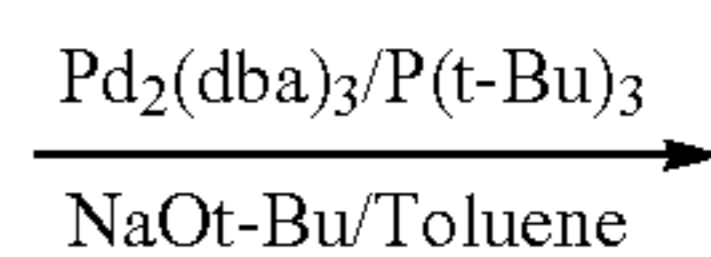
## Synthesis Example of 3-16



Sub 3(17)



Sub 4-56



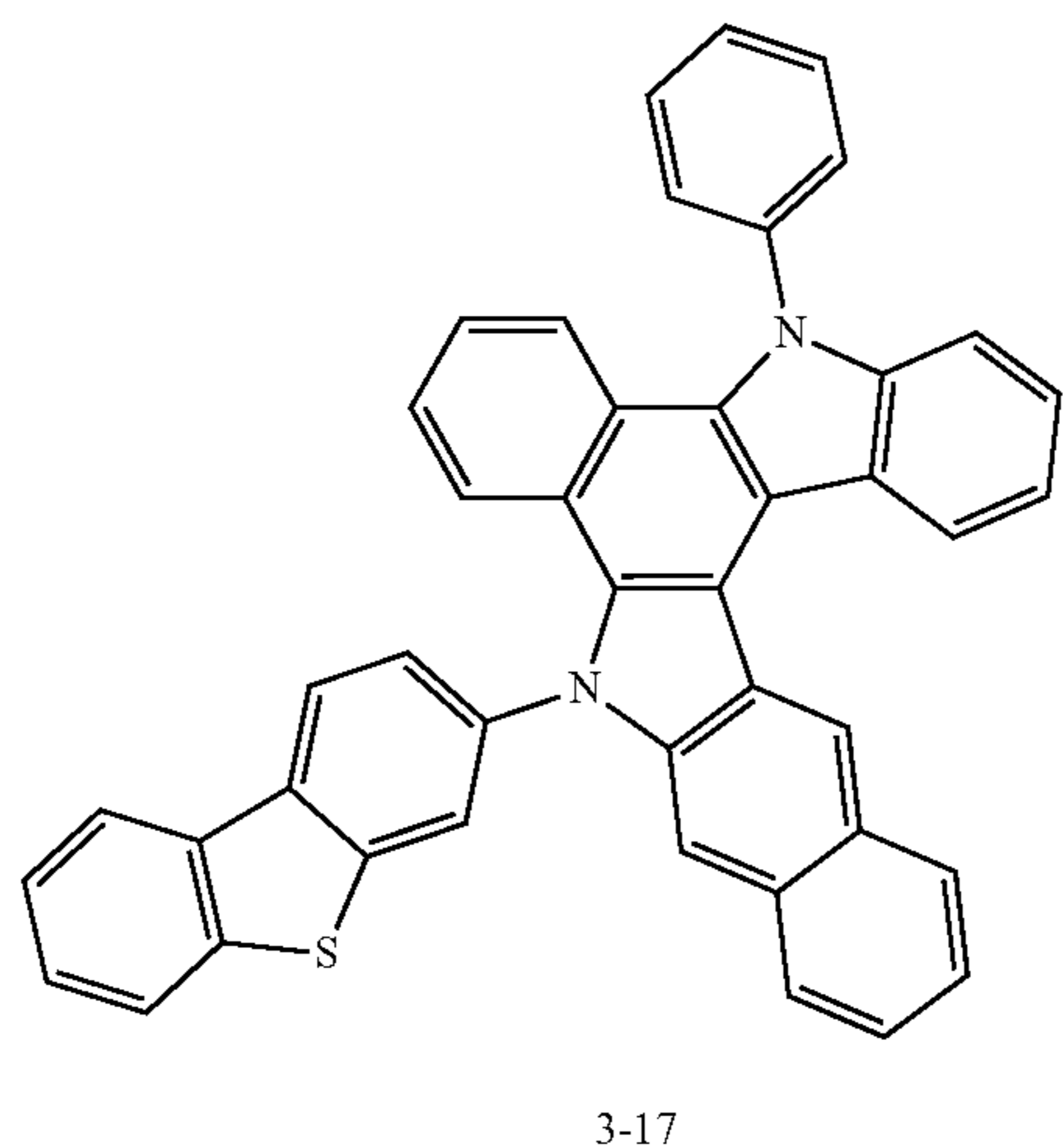
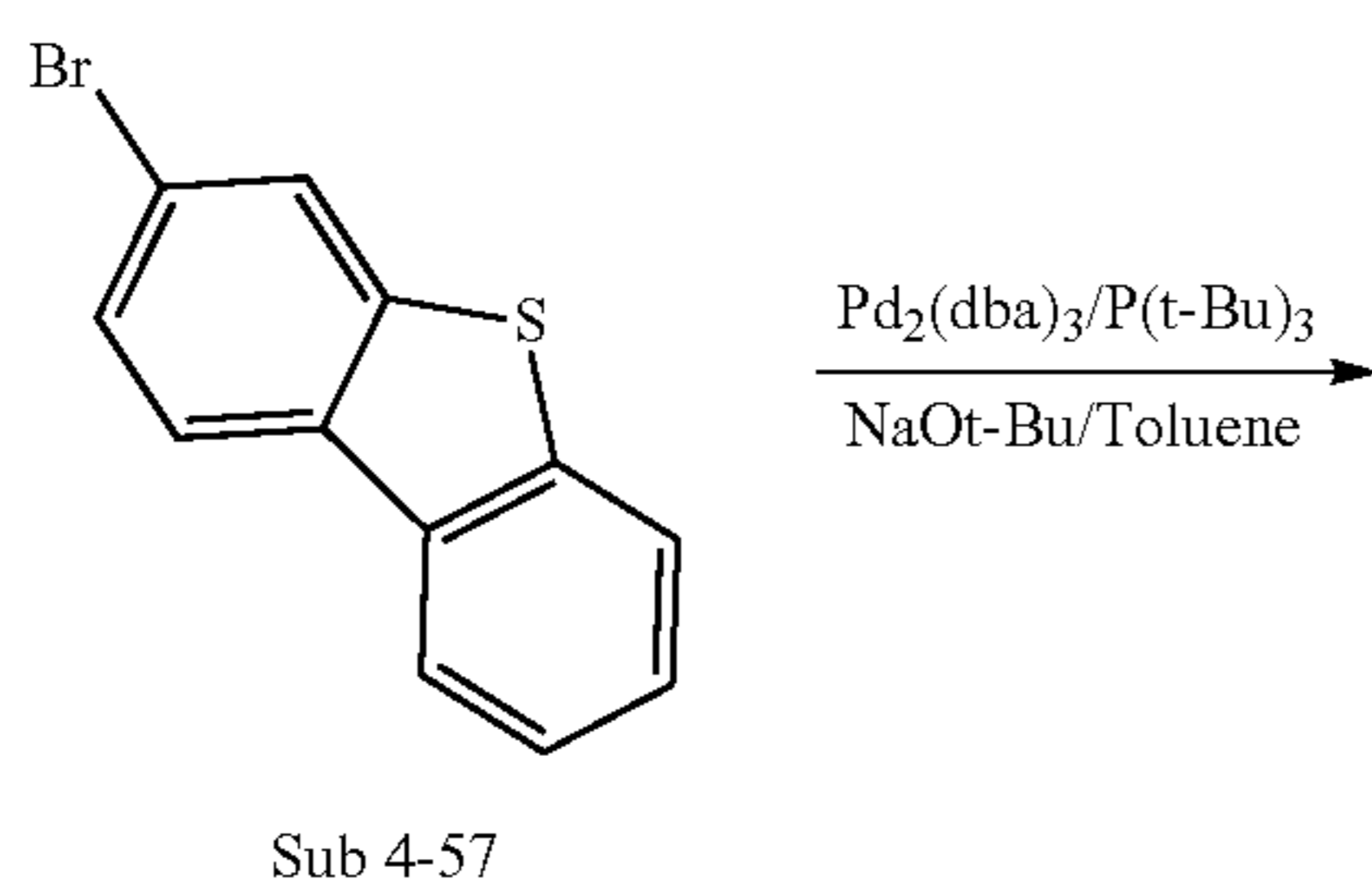
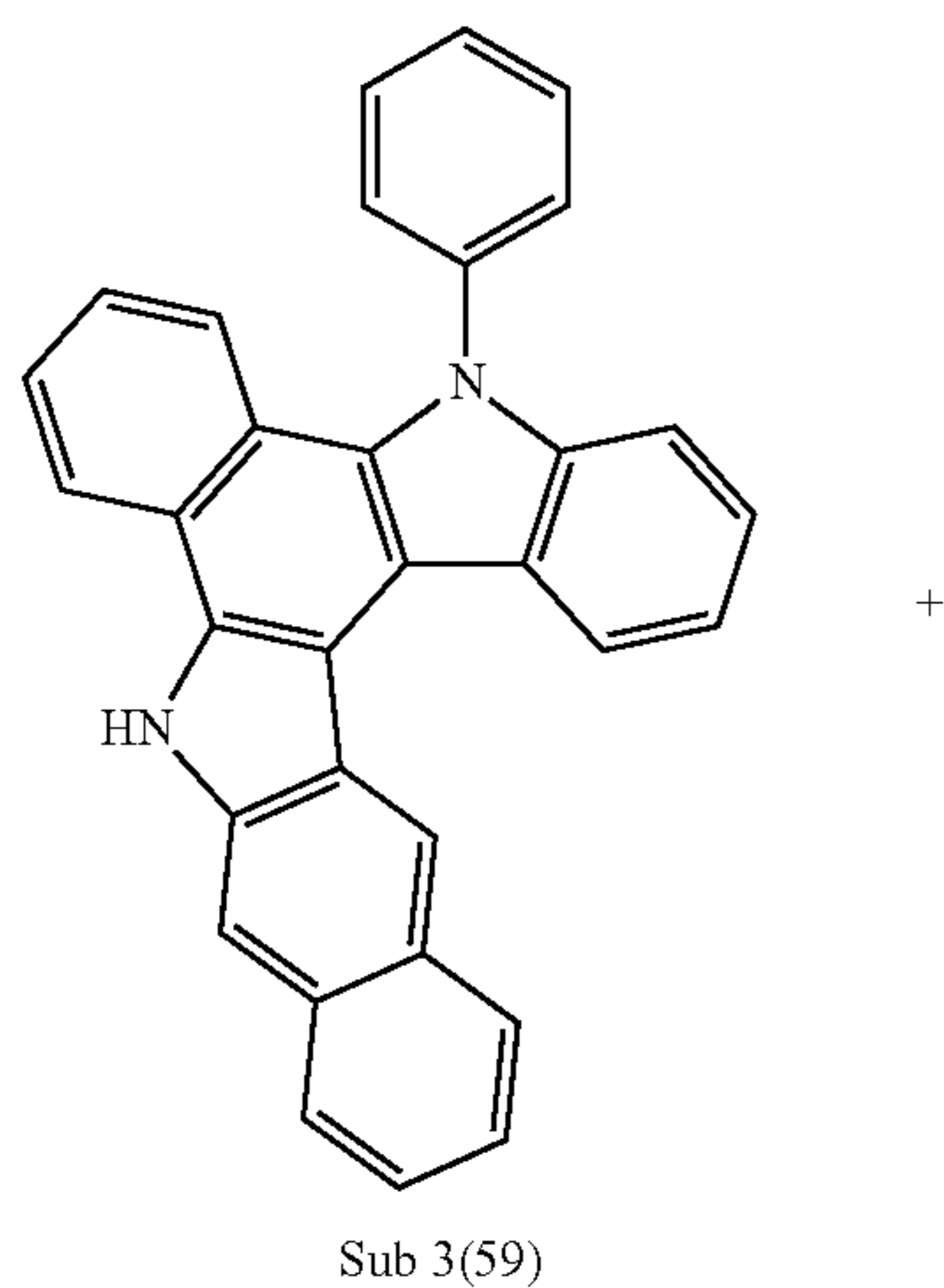
3-16

Sub 3(17) (18.1 g, 47.2 mmol), Sub 4-56 (16.7 g, 52.0 mmol) were added, the same procedure as described in the synthesis method of 3-6 was carried out to obtain 19.5 g of the final product. (Yield: 66%).



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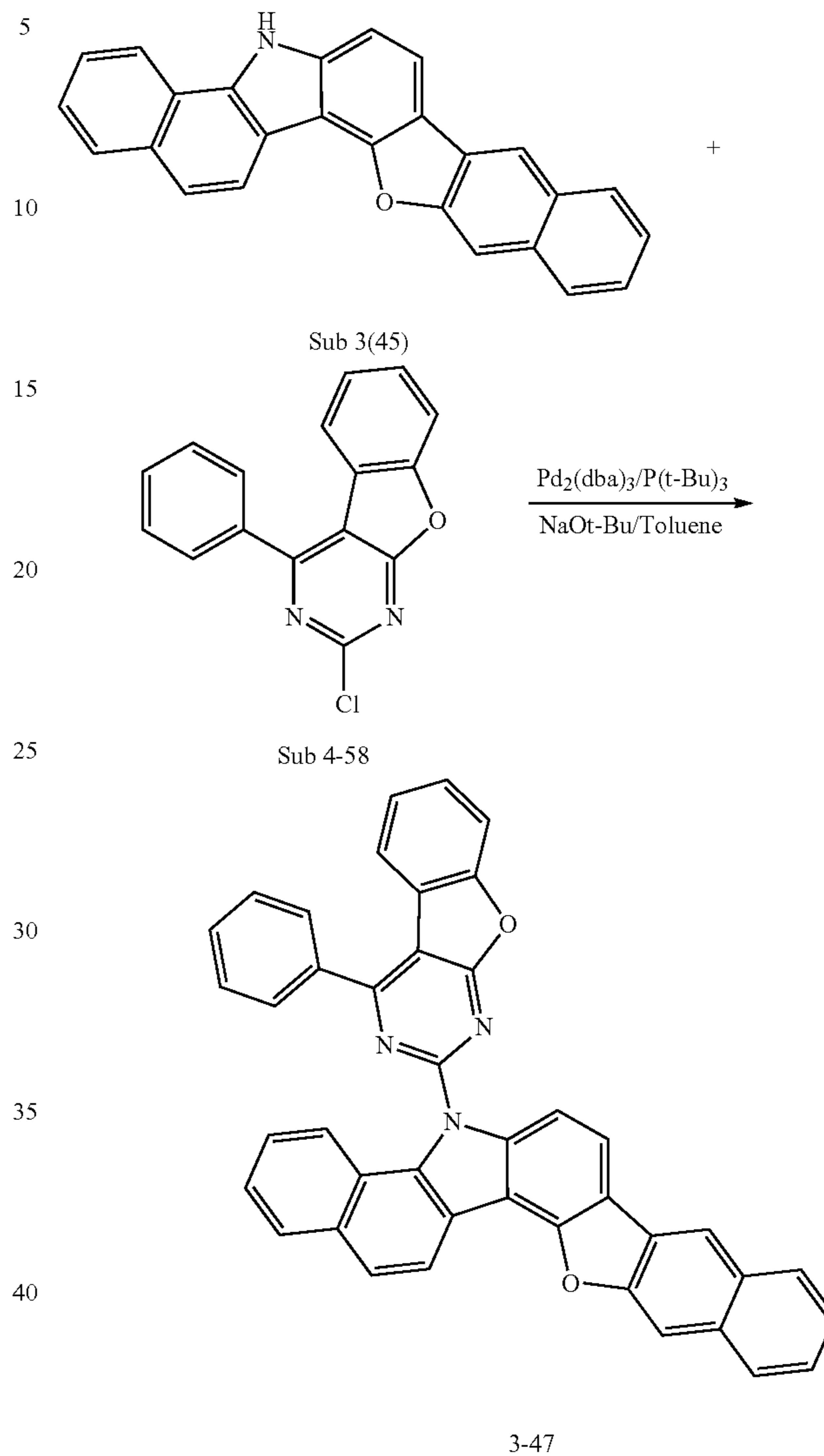
Synthesis Example of 3-17



Sub 3(59) (20.5 g, 47.4 mmol), Sub 4-57 (13.7 g, 52.0 mmol) were added, the same procedure as described in the synthesis method of 3-6 was carried out to obtain 20.4 g of the final product. (Yield: 70%).

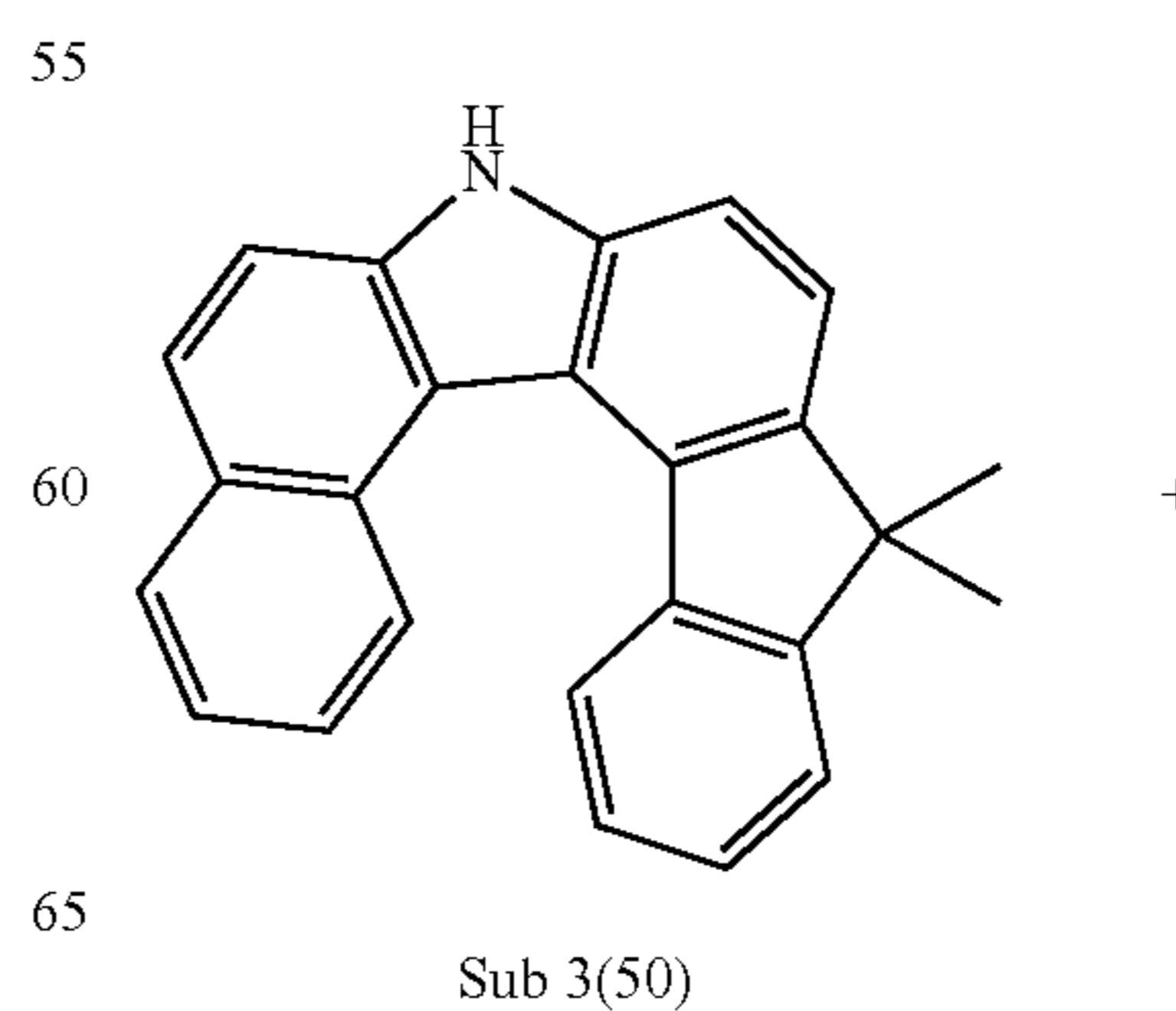
## 156

Synthesis Example of 3-47

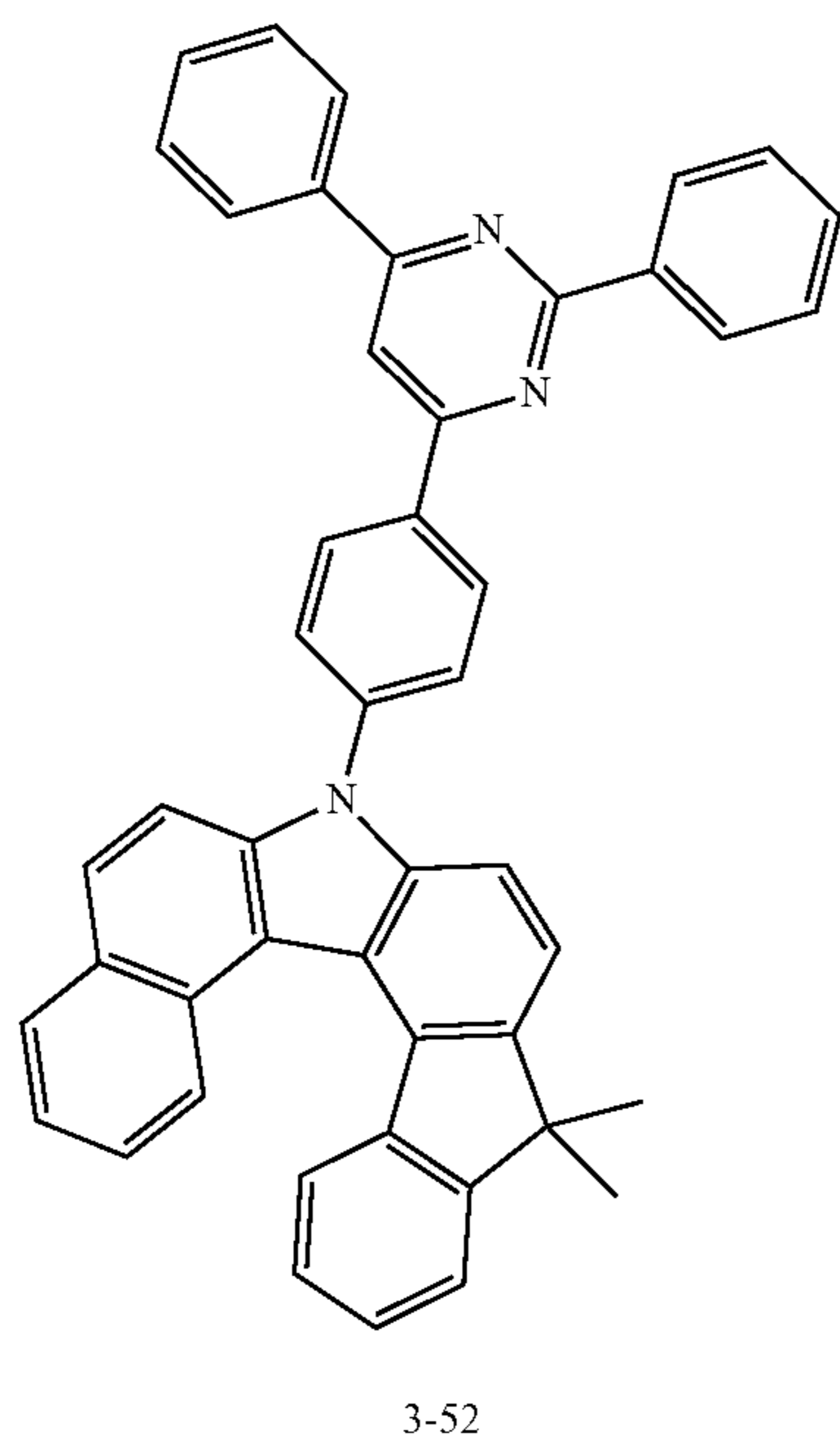
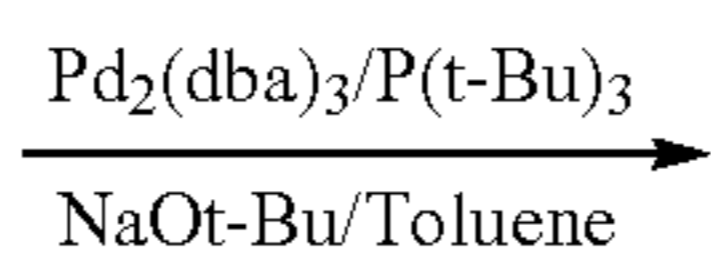
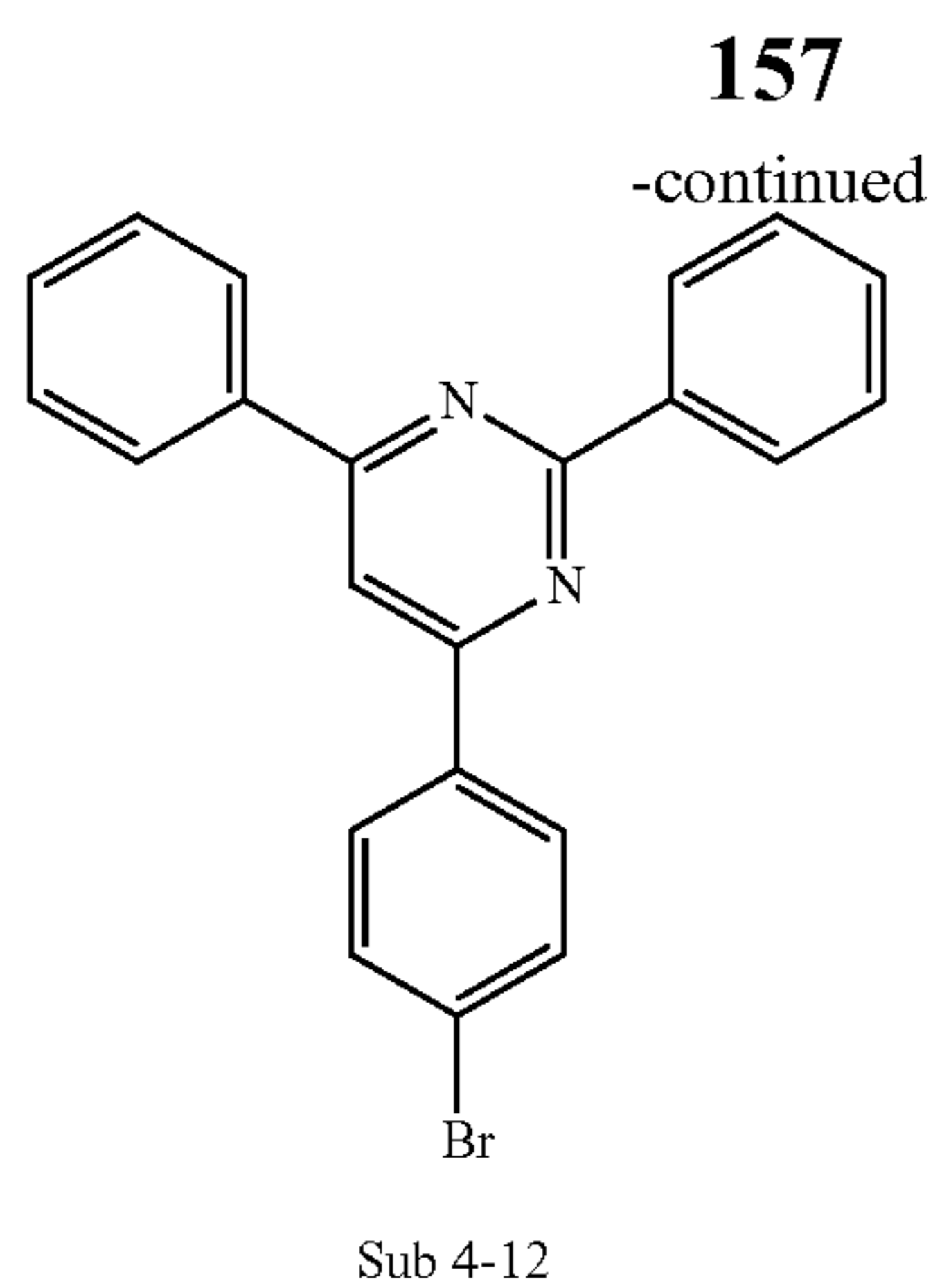


Sub 3(45) (16.9 g, 47.3 mmol), Sub 4-58 (14.6 g, 52.0 mmol) were added, the same procedure as described in the synthesis method of 3-6 was carried out to obtain 19.6 g of the final product. (Yield: 69%).

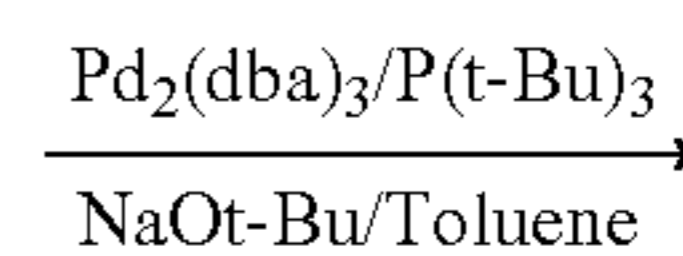
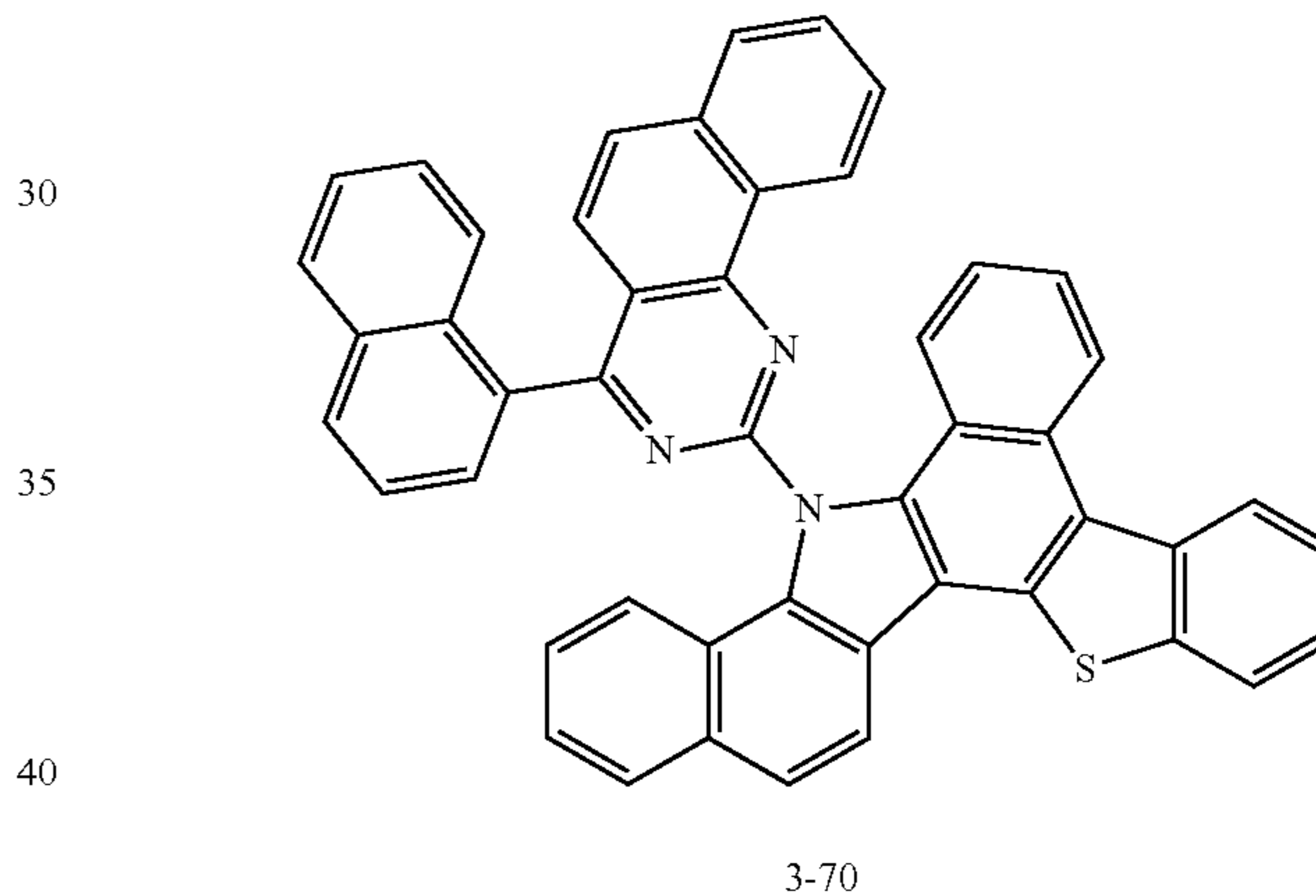
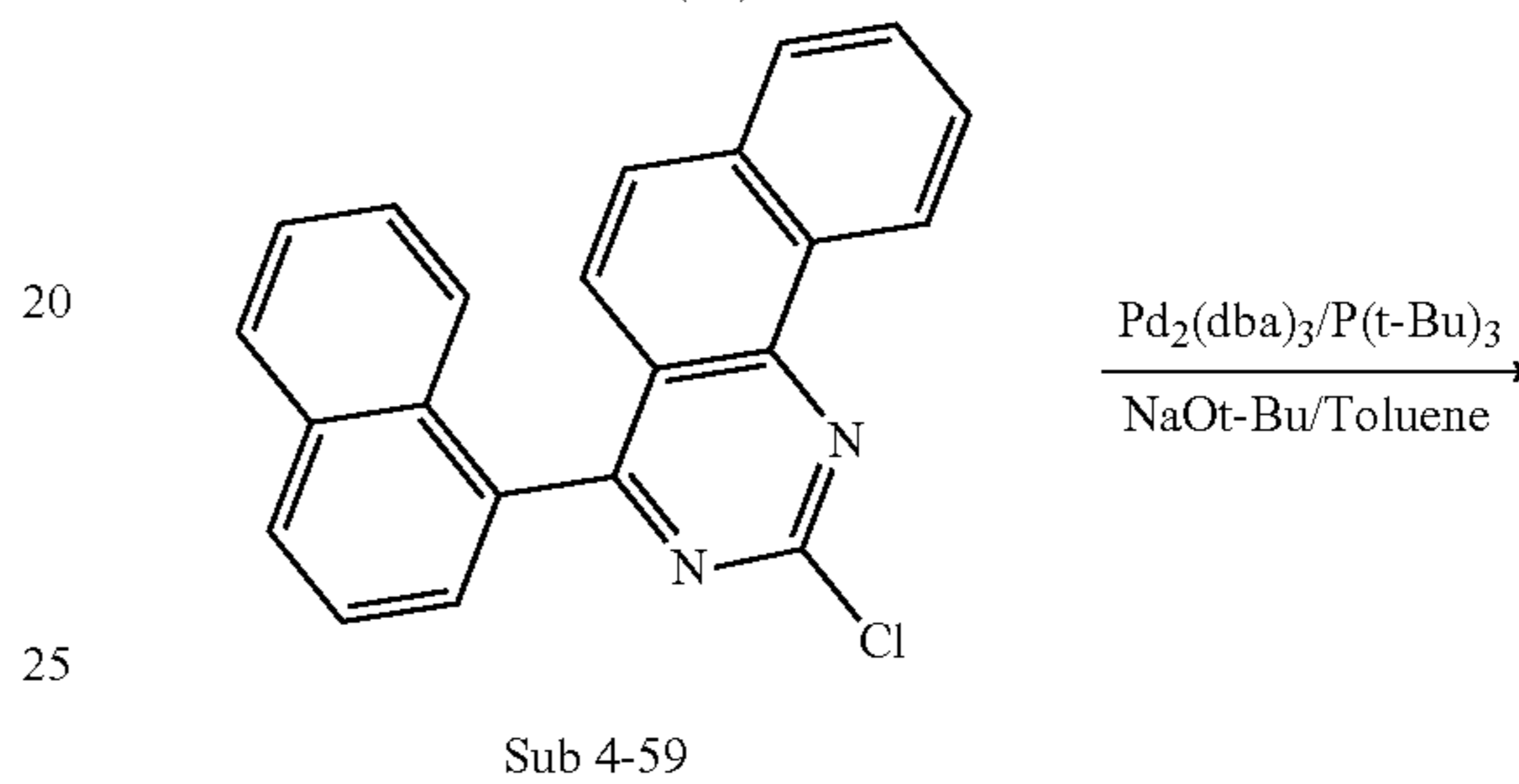
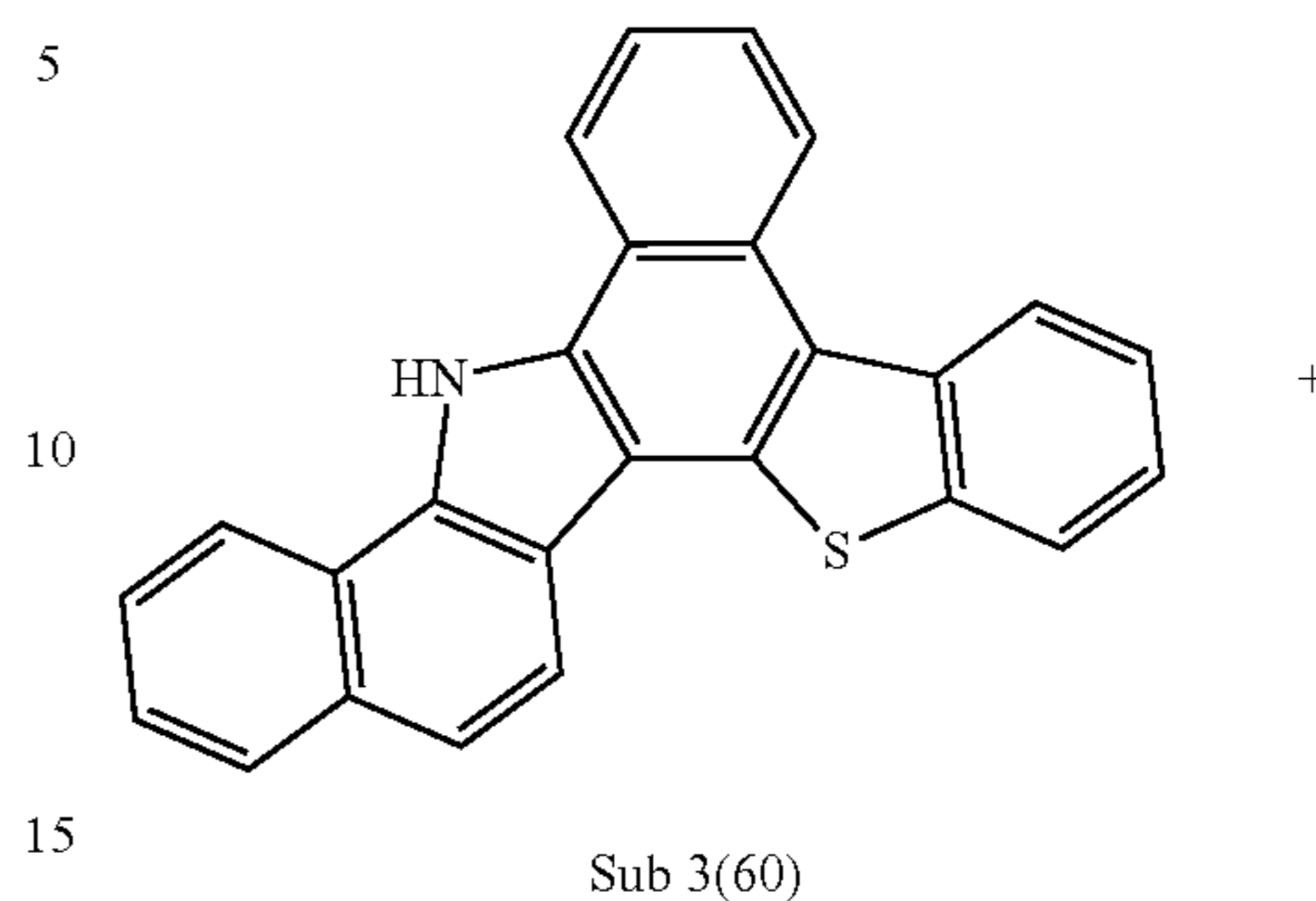
Synthesis Example of 3-52



65



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Synthesis Example of 3-70



Sub 3(50) (15.8 g, 47.4 mmol), Sub 4-12 (20.2 g, 52.0 mmol) were added, the same procedure as described in the synthesis method of 3-6 was carried out to obtain 21.2 g of the final product. (Yield: 70%).

Sub 3(60) (17.7 g, 47.4 mmol), Sub 4-59 (17.8 g, 52.0 mmol) were added, the same procedure as described in the synthesis method of 3-6 was carried out to obtain 23.4 g of the final product. (Yield: 73%).

TABLE 5

compound	FD-MS	compound	FD-MS
3-1	m/z = 458.18(C <sub>34</sub> H <sub>22</sub> N <sub>2</sub> = 458.56)	3-2	m/z = 449.12(C <sub>32</sub> H <sub>19</sub> NS = 449.57)
3-3	m/z = 433.15(C <sub>32</sub> H <sub>19</sub> NO = 433.51)	3-4	m/z = 535.23(C <sub>41</sub> H <sub>29</sub> N = 535.69)
3-5	m/z = 399.11(C <sub>28</sub> H <sub>17</sub> NS = 399.51)	3-6	m/z = 527.15(C <sub>36</sub> H <sub>21</sub> N <sub>3</sub> S = 527.65)
3-7	m/z = 583.12(C <sub>38</sub> H <sub>21</sub> N <sub>3</sub> S <sub>2</sub> = 583.73)	3-8	m/z = 577.16(C <sub>40</sub> H <sub>23</sub> N <sub>3</sub> S = 577.71)
3-9	m/z = 627.18(C <sub>44</sub> H <sub>25</sub> N <sub>3</sub> S = 627.77)	3-10	m/z = 475.14(C <sub>34</sub> H <sub>21</sub> NS = 475.61)
3-11	m/z = 585.21(C <sub>44</sub> H <sub>27</sub> NO = 585.71)	3-12	m/z = 509.21(C <sub>39</sub> H <sub>27</sub> N = 509.65)
3-13	m/z = 509.19(C <sub>37</sub> H <sub>23</sub> N <sub>3</sub> = 509.61)	3-14	m/z = 451.11(C <sub>30</sub> H <sub>17</sub> N <sub>3</sub> S = 451.55)
3-15	m/z = 588.20(C <sub>41</sub> H <sub>24</sub> N <sub>4</sub> O = 588.67)	3-16	m/z = 624.26(C <sub>47</sub> H <sub>32</sub> N <sub>2</sub> = 624.79)
3-17	m/z = 614.18(C <sub>44</sub> H <sub>26</sub> N <sub>2</sub> S = 614.77)	3-18	m/z = 449.12(C <sub>32</sub> H <sub>19</sub> NS = 449.57)
3-19	m/z = 573.17(C <sub>42</sub> H <sub>23</sub> NO <sub>2</sub> = 573.65)	3-20	m/z = 664.26(C <sub>48</sub> H <sub>32</sub> N <sub>4</sub> = 664.81)
3-21	m/z = 624.26(C <sub>47</sub> H <sub>32</sub> N <sub>2</sub> = 624.79)	3-22	m/z = 603.18(C <sub>42</sub> H <sub>25</sub> N <sub>3</sub> S = 603.74)
3-23	m/z = 664.23(C <sub>47</sub> H <sub>28</sub> N <sub>4</sub> O = 664.77)	3-24	m/z = 737.28(C <sub>55</sub> H <sub>35</sub> N <sub>3</sub> = 737.91)
3-25	m/z = 738.28(C <sub>54</sub> H <sub>34</sub> N <sub>4</sub> = 738.89)	3-26	m/z = 679.21(C <sub>48</sub> H <sub>29</sub> N <sub>3</sub> S = 679.84)
3-27	m/z = 625.22(C <sub>45</sub> H <sub>27</sub> N <sub>3</sub> O = 625.73)	3-28	m/z = 575.24(C <sub>42</sub> H <sub>29</sub> N <sub>3</sub> = 575.72)
3-29	m/z = 508.19(C <sub>38</sub> H <sub>24</sub> N <sub>2</sub> = 508.62)	3-30	m/z = 449.12(C <sub>32</sub> H <sub>19</sub> NS = 449.57)
3-31	m/z = 433.15(C <sub>32</sub> H <sub>19</sub> NO = 433.51)	3-32	m/z = 531.20(C <sub>41</sub> H <sub>25</sub> N = 531.66)
3-33	m/z = 608.23(C <sub>46</sub> H <sub>28</sub> N <sub>2</sub> = 608.74)	3-34	m/z = 475.14(C <sub>34</sub> H <sub>21</sub> NS = 475.61)
3-35	m/z = 384.13(C <sub>27</sub> H <sub>16</sub> N <sub>2</sub> O = 384.44)	3-36	m/z = 614.25(C <sub>44</sub> H <sub>30</sub> N <sub>4</sub> = 614.75)

TABLE 5-continued

compound	FD-MS	compound	FD-MS
3-37	m/z = 508.19(C <sub>38</sub> H <sub>24</sub> N <sub>2</sub> = 508.62)	3-38	m/z = 449.12(C <sub>32</sub> H <sub>19</sub> NS = 449.57)
3-39	m/z = 433.15(C <sub>32</sub> H <sub>19</sub> NO = 433.51)	3-40	m/z = 459.20(C <sub>35</sub> H <sub>25</sub> N = 459.59)
3-41	m/z = 663.24(C <sub>47</sub> H <sub>29</sub> NS = 663.78)	3-42	m/z = 603.18(C <sub>42</sub> H <sub>25</sub> N <sub>3</sub> S = 603.74)
3-43	m/z = 587.20(C <sub>42</sub> H <sub>25</sub> N <sub>3</sub> O = 587.68)	3-44	m/z = 613.25(C <sub>45</sub> H <sub>31</sub> N <sub>3</sub> = 613.76)
3-45	m/z = 662.25(C <sub>48</sub> H <sub>30</sub> N <sub>4</sub> = 662.80)	3-46	m/z = 577.16(C <sub>40</sub> H <sub>23</sub> N <sub>3</sub> S = 577.71)
3-47	m/z = 601.18(C <sub>42</sub> H <sub>23</sub> N <sub>3</sub> O <sub>2</sub> = 601.67)	3-48	m/z = 759.27(C <sub>57</sub> H <sub>33</sub> N <sub>3</sub> = 759.91)
3-49	m/z = 589.22(C <sub>42</sub> H <sub>26</sub> N <sub>4</sub> = 586.70)	3-50	m/z = 630.19(C <sub>43</sub> H <sub>26</sub> N <sub>4</sub> S = 630.77)
3-51	m/z = 613.22(C <sub>44</sub> H <sub>27</sub> N <sub>3</sub> O = 613.72)	3-52	m/z = 639.27(C <sub>47</sub> H <sub>33</sub> N <sub>3</sub> = 639.80)
3-53	m/z = 508.19(C <sub>38</sub> H <sub>24</sub> N <sub>2</sub> = 508.62)	3-54	m/z = 449.12(C <sub>32</sub> H <sub>19</sub> NS = 449.57)
3-55	m/z = 433.15(C <sub>32</sub> H <sub>19</sub> NO = 433.51)	3-56	m/z = 609.25(C <sub>47</sub> H <sub>31</sub> N = 609.77)
3-57	m/z = 663.24(C <sub>47</sub> H <sub>29</sub> NS = 663.78)	3-58	m/z = 604.17(C <sub>41</sub> H <sub>24</sub> N <sub>4</sub> S = 604.73)
3-59	m/z = 587.20(C <sub>42</sub> H <sub>25</sub> N <sub>3</sub> O = 587.68)	3-60	m/z = 613.25(C <sub>45</sub> H <sub>31</sub> N <sub>3</sub> = 613.76)
3-61	m/z = 527.15(C <sub>36</sub> H <sub>21</sub> N <sub>3</sub> S = 527.65)	3-62	m/z = 603.18(C <sub>42</sub> H <sub>25</sub> N <sub>3</sub> S = 603.74)
3-63	m/z = 511.17(C <sub>36</sub> H <sub>21</sub> N <sub>3</sub> O = 511.58)	3-64	m/z = 587.24(C <sub>43</sub> H <sub>29</sub> N <sub>3</sub> = 587.73)
3-65	m/z = 692.20(C <sub>48</sub> H <sub>28</sub> N <sub>4</sub> S = 692.84)	3-66	m/z = 577.16(C <sub>40</sub> H <sub>23</sub> N <sub>3</sub> S = 577.71)
3-67	m/z = 561.18(C <sub>40</sub> H <sub>23</sub> N <sub>3</sub> O = 561.64)	3-68	m/z = 653.19(C <sub>46</sub> H <sub>27</sub> N <sub>3</sub> S = 653.80)
3-69	m/z = 736.26(C <sub>54</sub> H <sub>32</sub> N <sub>4</sub> = 736.88)	3-70	m/z = 677.19(C <sub>48</sub> H <sub>27</sub> N <sub>3</sub> S = 677.83)
3-71	m/z = 687.23(C <sub>50</sub> H <sub>29</sub> N <sub>3</sub> O = 687.80)	3-72	m/z = 743.24(C <sub>53</sub> H <sub>33</sub> N <sub>3</sub> S = 743.93)
3-73	m/z = 703.21(C <sub>50</sub> H <sub>29</sub> N <sub>3</sub> S = 703.86)	3-74	m/z = 603.18(C <sub>42</sub> H <sub>25</sub> N <sub>3</sub> S = 603.74)
3-75	m/z = 735.18(C <sub>50</sub> H <sub>29</sub> N <sub>3</sub> S <sub>2</sub> = 735.92)	3-76	m/z = 759.18(C <sub>52</sub> H <sub>29</sub> N <sub>3</sub> S <sub>2</sub> = 759.95)
3-77	m/z = 475.14(C <sub>34</sub> H <sub>21</sub> NS = 475.61)	3-78	m/z = 616.20(C <sub>44</sub> H <sub>28</sub> N <sub>2</sub> S = 616.78)
3-79	m/z = 710.16(C <sub>47</sub> H <sub>26</sub> N <sub>4</sub> S <sub>2</sub> = 710.87)	3-80	m/z = 818.25(C <sub>58</sub> H <sub>34</sub> N <sub>4</sub> S = 819.00)
3-81	m/z = 844.27(C <sub>60</sub> H <sub>36</sub> N <sub>4</sub> S = 845.04)	3-82	m/z = 667.17(C <sub>46</sub> H <sub>25</sub> N <sub>3</sub> OS = 667.79)
3-83	m/z = 703.80(C <sub>50</sub> H <sub>29</sub> N <sub>3</sub> O <sub>2</sub> = 703.80)	3-84	m/z = 629.21(C <sub>44</sub> H <sub>27</sub> N <sub>3</sub> O <sub>2</sub> = 629.72)

Otherwise, the synthesis examples of the present invention represented by Formulas (1) and (2) have been described, but these are all based on the Buchwald-Hartwig cross coupling reaction, Suzuki cross-coupling reaction, Intramolecular acid-induced cyclization reaction (J. mater. Chem. 1999, 9, 2095), Pd(II)-catalyzed oxidative cyclization reaction (Org. Lett. 2011, 13, 5504), Grignard reaction, Cyclic Dehydration reaction and PPh<sub>3</sub>-mediated reductive cyclization reaction (J. Org. Chem. 2005, 70, 5014), and those skilled in the art will readily understand that the above reaction proceeds even when, besides the substituent specified in the specific synthesis example, other substituents (R<sup>1</sup> to R<sup>5</sup>, Ar<sup>1</sup> to Ar<sup>4</sup>, L<sup>1</sup> to L<sup>2</sup>, X<sup>1</sup> to X<sup>2</sup>) defined in Formula (1) are bonded.

For example, Sub 1+Sub 2→Final Products 1 reaction in Reaction Scheme 1, the synthetic reaction of Sub 2 in Reaction Scheme 2, Sub 3+Sub 4→Final Products 2 reaction in Reaction Scheme 3 are all based on the Buchwald-Hartwig cross coupling reaction, and Sub 3-2+Sub 3-3→Sub 3-4 reaction in Reaction Scheme 4 is based on the Suzuki cross-coupling reaction, and Sub 3-4→Sub 3 in Reaction Scheme 4 is based on the PPh<sub>3</sub>-mediated reductive cyclization reaction (J. Org. Chem. 2005, 70, 5014.) The above reactions will proceed even if a substituent not specifically mentioned is bonded.

Evaluation of Manufacture of Organic Electric element

#### Example 1) Manufacture and Evaluation of Red Organic Light Emitting Diode

First, on an ITO layer(anode) formed on a glass substrate, N<sup>1</sup>-(naphthalen-2-yl)-N<sup>4</sup>,N<sup>4</sup>-bis(4-(naphthalen-2-yl(phenyl) amino)phenyl)-N<sup>1</sup>-phenyl benzene-1,4-diamine (hereinafter will be abbreviated as 2-TNATA) was vacuum-deposited to form a hole injection layer with a thickness of 60 nm, and N,N'-bis(1-naphthalenyl)-N,N'-bis-phenyl-(1,1'-biphenyl)-4,4'-diamine (hereinafter will be abbreviated as NPB) was vacuum-deposited to form a hole transport layer with a thickness of 60 nm. On the hole transport layer, a mixture of the compounds represented by Formulas (1) and (2) as a host in a ratio of 3:7 was used as a host, and as a dopant, an emitting layer with a thickness of 30 nm was deposited on

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the hole transport layer by doping (piq)<sub>2</sub>Ir(acac) [bis-(1-phenylisoquinolyl)iridium(III)acetylacetonate] with a weight of 95:5. (1,1'-bis(phenyl)-4-olato)bis(2-methyl-8-quinolinolato)aluminum (hereinafter abbreviated as BALq) was vacuum deposited as a hole blocking layer to a thickness of 10 nm, and tris(8-quinolinol)aluminum (hereinafter abbreviated as Alq<sub>3</sub>) was deposited to a thickness of 40 nm as an electron transport layer. After that, an alkali metal halide, LiF was vacuum deposited as an electron injection layer to a thickness of 0.2 nm, and Al was deposited to a thickness of 150 nm to form a cathode to manufacture an OLED.

To the OLEDs which were manufactured by examples and comparative examples, a forward bias direct current voltage was applied, and electroluminescent (EL) properties were measured using PR-650 of Photoresearch Co., and T95 life was measured using a life measuring apparatus manufactured by McScience Inc. with a reference luminance of 2500 cd/m<sup>2</sup>. In the following table, the manufacture of a device and the results of evaluation are shown.

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#### Comparative Examples 1 to 3

An organic electroluminescent device was manufactured in the same manner as in Example 1, except that the compound represented by Formula (2) was used as a host alone.

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#### Comparative Example 4

An organic electroluminescent device was manufactured in the same manner as in Example 1, except that the comparative compound 1 was used as a host alone.

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#### Comparative Example 5

An organic electroluminescent device was manufactured in the same manner as in Example 1, except that the comparative compound 2 was used as a host alone.

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#### Comparative Example 6

An organic electroluminescent device was manufactured in the same manner as in Example 1, except that the comparative compound 3 was used as a host alone.

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## Comparative Example 7

An organic electroluminescent device was manufactured in the same manner as in Example 1, except that the comparative compound 4 was used as a host.

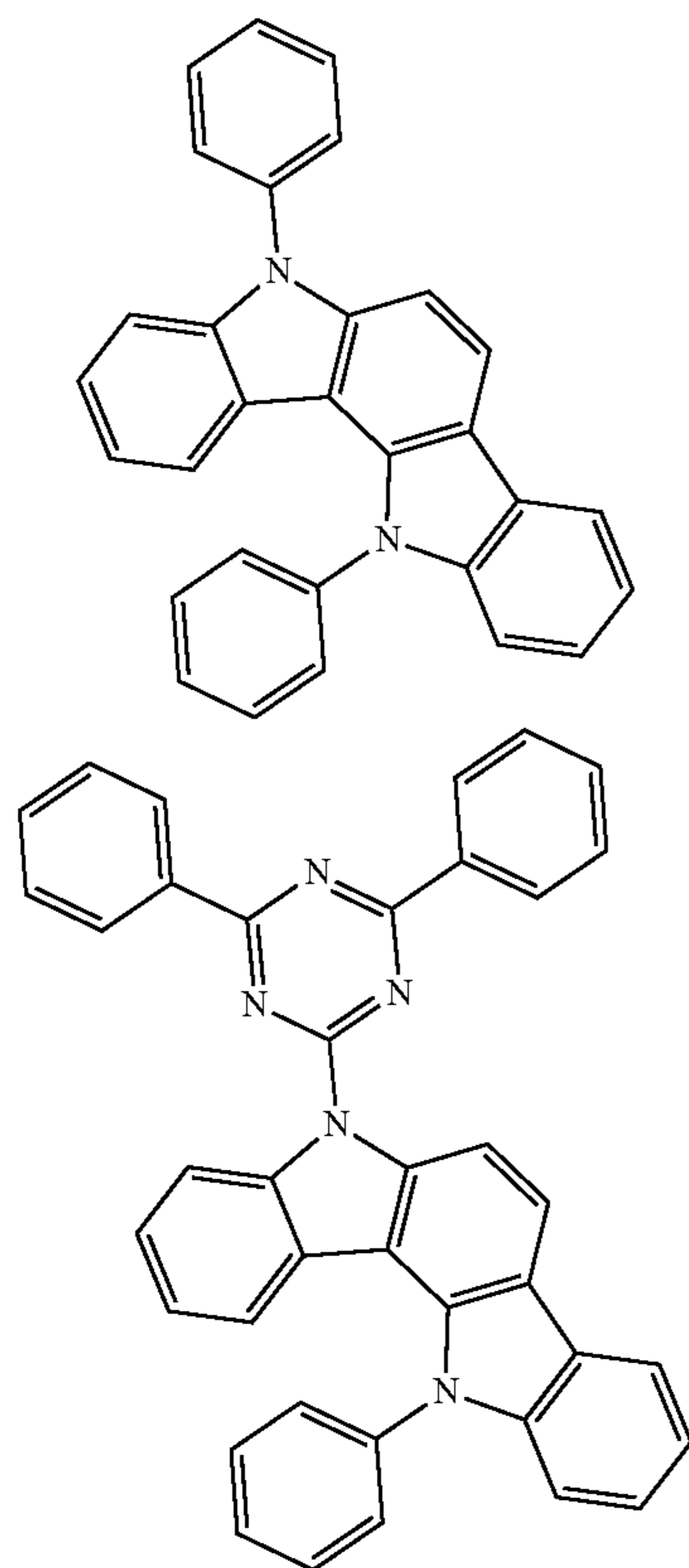
## Comparative Example 8

An organic electroluminescent device was manufactured in the same manner as in Example 1, except that comparative compound 1 and 2 were mixed and used as a host.

## Comparative Example 9

An organic electroluminescent device was manufactured in the same manner as in Example 1, except that comparative compound 3 and 4 were mixed and used as a host.

comparative compound 1 comparative compound 2 comparative compound 3 comparative compound 4

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-continued

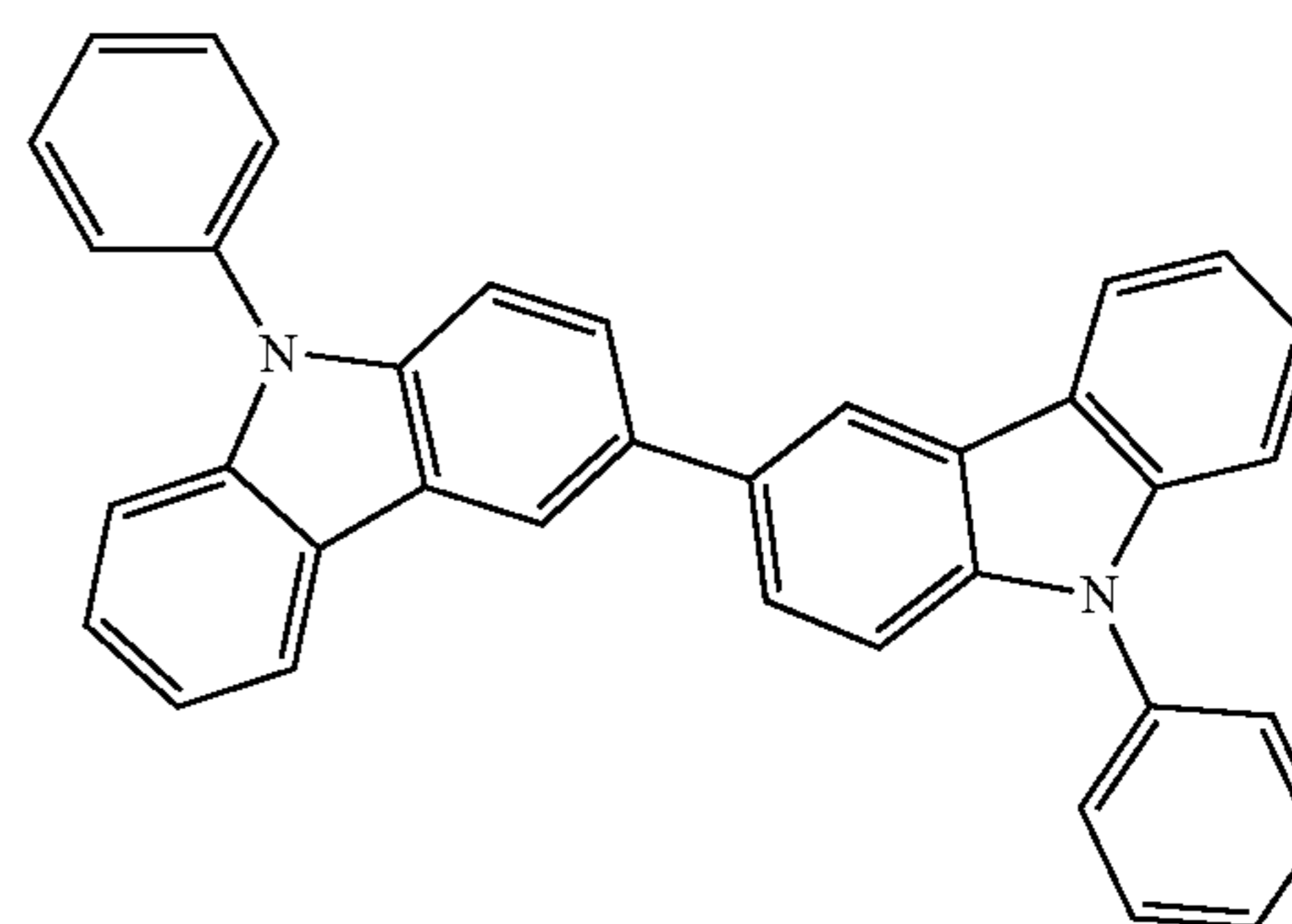
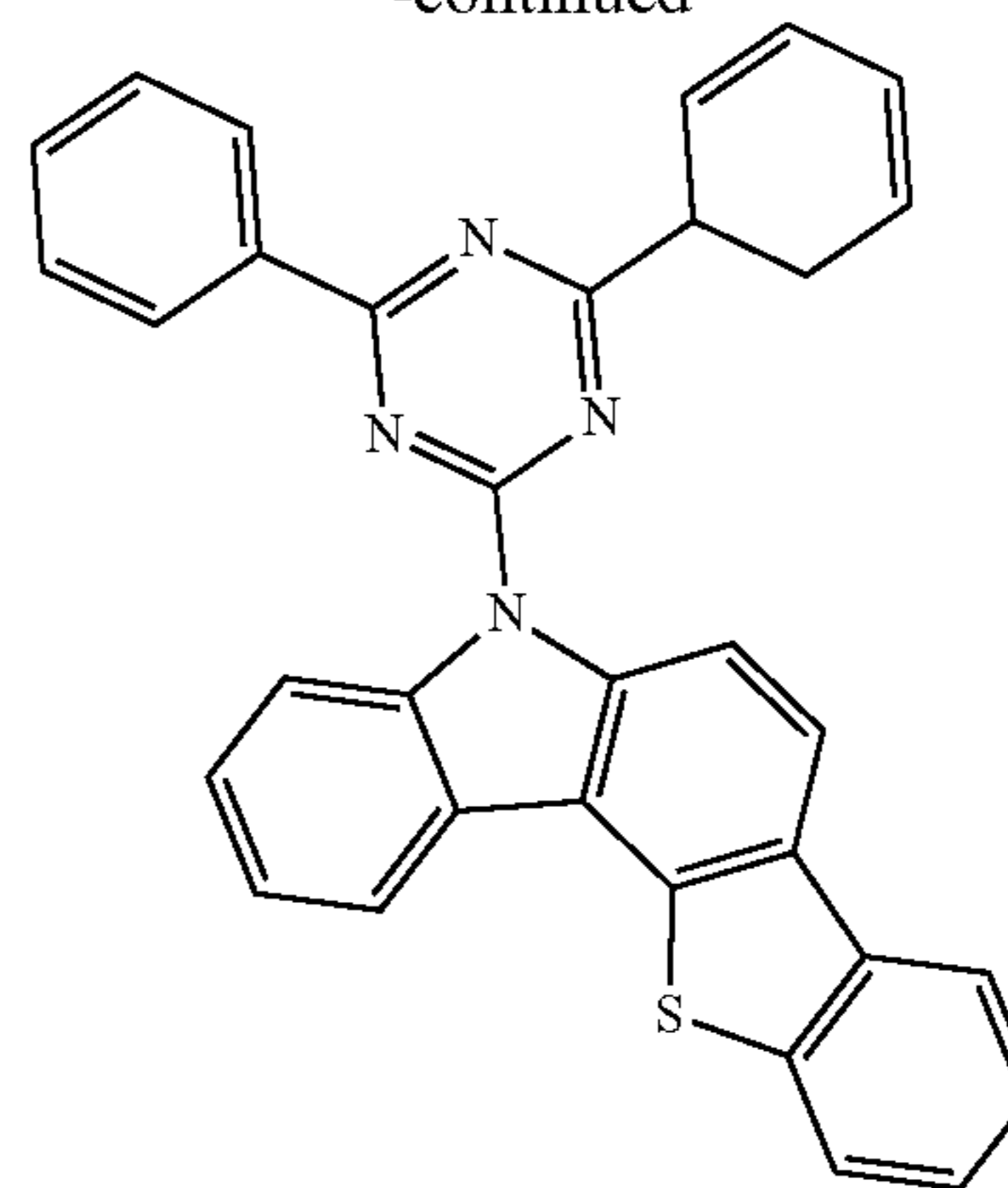


TABLE 6

	First host	Second host	Voltage	Current Density	Brightness (cd/m <sup>2</sup> )	Efficiency	Lifetime T (95)
comparative example (1)	—	compound (3-6)	6.3	17.9	2500.0	14.0	105.7
comparative example (2)	—	compound (3-61)	6.5	18.2	2500.0	13.7	104.2
comparative example (3)	—	compound (3-74)	6.6	18.9	2500.0	13.2	101.6
comparative example (4)	—	comparative compound 1	7.1	20.4	2500.0	12.3	80.3
comparative example (5)	—	comparative compound 2	7.0	20.0	2500.0	12.5	81.9
comparative example (6)	—	comparative compound 3	6.9	19.5	2500.0	12.8	85.4

TABLE 6-continued

	First host	Second host	Voltage	Current Density	Brightness (cd/m <sup>2</sup> )	Efficiency	Lifetime T (95)
comparative example (7)	—	comparative compound 4	7.1	20.2	2500.0	12.4	80.9
comparative example (8)	comparative compound 1	comparative compound 2	6.2	13.0	2500.0	19.3	102.8
comparative example (9)	comparative compound 3	comparative compound 4	6.0	12.4	2500.0	20.1	105.9
example (1)	compound (1-4')	compound (3-6)	5.3	8.2	2500.0	30.5	131.1
example (2)	compound (1-10')	compound (3-6)	5.3	7.8	2500.0	31.9	130.6
example (3)	compound (1-16')	compound (3-6)	5.1	8.3	2500.0	30.2	131.6
example (4)	compound (1-21')	compound (3-6)	5.3	7.7	2500.0	32.4	132.4
example (5)	compound (1-33')	compound (3-6)	5.5	7.6	2500.0	32.7	132.9
example (6)	compound (1-45')	compound (3-6)	5.1	7.8	2500.0	32.1	132.7
example (7)	compound (1-48')	compound (3-6)	5.4	7.4	2500.0	33.9	134.6
example (8)	compound (1-50')	compound (3-6)	5.4	7.3	2500.0	34.1	133.5
example (9)	compound (1-55')	compound (3-6)	5.1	7.3	2500.0	34.2	134.3
example (10)	compound (1-56')	compound (3-6)	5.2	7.4	2500.0	33.9	133.2
example (11)	compound (1-4')	compound (3-7)	5.3	9.8	2500.0	25.6	120.7
example (12)	compound (1-10')	compound (3-7)	5.3	9.9	2500.0	25.3	120.5
example (13)	compound (1-16')	compound (3-7)	5.2	9.7	2500.0	25.7	120.7
example (14)	compound (1-21')	compound (3-7)	5.1	9.4	2500.0	26.5	122.7
example (15)	compound (1-33')	compound (3-7)	5.1	9.4	2500.0	26.5	121.7
example (16)	compound (1-45')	compound (3-7)	5.4	9.5	2500.0	26.4	121.8
example (17)	compound (1-48')	compound (3-7)	5.1	9.2	2500.0	27.1	123.5
example (18)	compound (1-50')	compound (3-7)	5.4	9.0	2500.0	27.8	124.8
example (19)	compound (1-55')	compound (3-7)	5.3	9.1	2500.0	27.6	123.0
example (20)	compound (1-56')	compound (3-7)	5.1	9.2	2500.0	27.2	124.2
example (21)	compound (1-4')	compound (3-8)	5.2	9.6	2500.0	25.9	120.2
example (22)	compound (1-10')	compound (3-8)	5.5	9.8	2500.0	25.6	120.6
example (23)	compound (1-16')	compound (3-8)	5.4	9.8	2500.0	25.5	120.5
example (24)	compound (1-21')	compound (3-8)	5.2	9.5	2500.0	26.3	122.1
example (25)	compound (1-33')	compound (3-8)	5.4	9.6	2500.0	26.1	121.2
example (26)	compound (1-45')	compound (3-8)	5.3	9.5	2500.0	26.4	121.0
example (27)	compound (1-48')	compound (3-8)	5.3	9.1	2500.0	27.6	124.4
example (28)	compound (1-50')	compound (3-8)	5.2	9.0	2500.0	27.7	123.1
example (29)	compound (1-55')	compound (3-8)	5.3	9.2	2500.0	27.2	124.6
example (30)	compound (1-56')	compound (3-8)	5.3	9.0	2500.0	27.6	124.3
example (31)	compound (1-4')	compound (3-9)	5.4	10.0	2500.0	25.1	120.1
example (32)	compound (1-10')	compound (3-9)	5.2	9.8	2500.0	25.5	120.8
example (33)	compound (1-16')	compound (3-9)	5.1	10.0	2500.0	25.0	120.3
example (34)	compound (1-21')	compound (3-9)	5.4	9.3	2500.0	26.9	121.8
example (35)	compound (1-33')	compound (3-9)	5.4	9.6	2500.0	26.1	122.5
example (36)	compound (1-45')	compound (3-9)	5.1	9.4	2500.0	26.5	122.2
example (37)	compound (1-48')	compound (3-9)	5.0	9.2	2500.0	27.2	123.3
example (38)	compound (1-50')	compound (3-9)	5.2	9.0	2500.0	27.9	125.0

TABLE 6-continued

	First host	Second host	Voltage	Current Density	Brightness (cd/m <sup>2</sup> )	Efficiency	Lifetime T (95)
example (39)	compound (1-55')	compound (3-9)	5.5	9.1	2500.0	27.4	124.0
example (40)	compound (1-56')	compound (3-9)	5.3	9.2	2500.0	27.3	124.9
example (41)	compound (1-4')	compound (3-15)	5.4	9.9	2500.0	25.2	120.5
example (42)	compound (1-10')	compound (3-15)	5.0	9.8	2500.0	25.4	120.3
example (43)	compound (1-16')	compound (3-15)	5.0	9.9	2500.0	25.2	120.5
example (44)	compound (1-21')	compound (3-15)	5.2	9.6	2500.0	26.1	121.7
example (45)	compound (1-33')	compound (3-15)	5.4	9.4	2500.0	26.7	121.9
example (46)	compound (1-45')	compound (3-15)	5.5	9.3	2500.0	26.8	121.6
example (47)	compound (1-48')	compound (3-15)	5.3	9.2	2500.0	27.3	123.4
example (48)	compound (1-50')	compound (3-15)	5.1	9.3	2500.0	27.0	124.3
example (49)	compound (1-55')	compound (3-15)	5.4	9.1	2500.0	27.5	124.5
example (50)	compound (1-56')	compound (3-15)	5.1	9.0	2500.0	27.8	124.0
example (51)	compound (1-4')	compound (3-37)	5.0	9.8	2500.0	25.6	120.8
example (52)	compound (1-10')	compound (3-37)	5.2	9.9	2500.0	25.2	120.3
example (53)	compound (1-16')	compound (3-37)	5.4	9.9	2500.0	25.4	120.2
example (54)	compound (1-21')	compound (3-37)	5.5	9.4	2500.0	26.6	122.2
example (55)	compound (1-33')	compound (3-37)	5.3	9.5	2500.0	26.4	121.7
example (56)	compound (1-45')	compound (3-37)	5.3	9.5	2500.0	26.3	122.5
example (57)	compound (1-48')	compound (3-37)	5.2	8.9	2500.0	28.0	124.6
example (58)	compound (1-50')	compound (3-37)	5.4	9.1	2500.0	27.4	123.9
example (59)	compound (1-55')	compound (3-37)	5.3	8.9	2500.0	28.0	123.7
example (60)	compound (1-56')	compound (3-37)	5.1	9.0	2500.0	27.6	123.5
example (61)	compound (1-4')	compound (3-46)	5.3	9.6	2500.0	25.9	120.9
example (62)	compound (1-10')	compound (3-46)	5.2	9.9	2500.0	25.4	120.9
example (63)	compound (1-16')	compound (3-46)	5.3	9.8	2500.0	25.6	120.5
example (64)	compound (1-21')	compound (3-46)	5.0	9.3	2500.0	26.7	121.0
example (65)	compound (1-33')	compound (3-46)	5.3	9.6	2500.0	26.2	122.5
example (66)	compound (1-45')	compound (3-46)	5.2	9.5	2500.0	26.4	121.4
example (67)	compound (1-48')	compound (3-46)	5.2	9.2	2500.0	27.3	123.0
example (68)	compound (1-50')	compound (3-46)	5.4	9.1	2500.0	27.4	124.7
example (69)	compound (1-55')	compound (3-46)	5.0	9.3	2500.0	27.0	124.8
example (70)	compound (1-56')	compound (3-46)	5.2	8.9	2500.0	27.9	123.3
example (71)	compound (1-4')	compound (3-50)	5.4	9.9	2500.0	25.3	120.6
example (72)	compound (1-10')	compound (3-50)	5.4	9.9	2500.0	25.1	120.5
example (73)	compound (1-16')	compound (3-50)	5.2	10.0	2500.0	25.1	120.4
example (74)	compound (1-21')	compound (3-50)	5.3	9.5	2500.0	26.2	122.6
example (75)	compound (1-33')	compound (3-50)	5.5	9.3	2500.0	26.9	121.5
example (76)	compound (1-45')	compound (3-50)	5.3	9.4	2500.0	26.5	121.2

TABLE 6-continued

	First host	Second host	Voltage	Current Density	Brightness (cd/m <sup>2</sup> )	Efficiency	Lifetime T (95)
example (77)	compound (1-48')	compound (3-50)	5.3	8.9	2500.0	28.0	123.6
example (78)	compound (1-50')	compound (3-50)	5.1	9.0	2500.0	27.9	124.3
example (79)	compound (1-55')	compound (3-50)	5.0	9.0	2500.0	27.8	124.2
example (80)	compound (1-56')	compound (3-50)	5.4	9.0	2500.0	27.9	124.7
example (81)	compound (1-4')	compound (3-61)	5.1	8.6	2500.0	28.9	125.0
example (82)	compound (1-10')	compound (3-61)	5.3	8.9	2500.0	28.2	126.5
example (83)	compound (1-16')	compound (3-61)	5.1	8.8	2500.0	28.3	126.3
example (84)	compound (1-21')	compound (3-61)	5.2	8.4	2500.0	29.6	127.3
example (85)	compound (1-33')	compound (3-61)	5.5	8.5	2500.0	29.4	127.5
example (86)	compound (1-45')	compound (3-61)	5.0	8.3	2500.0	30.0	127.4
example (87)	compound (1-48')	compound (3-61)	5.4	8.1	2500.0	30.8	129.5
example (88)	compound (1-50')	compound (3-61)	5.3	8.2	2500.0	30.3	128.7
example (89)	compound (1-55')	compound (3-61)	5.4	8.1	2500.0	30.9	128.1
example (90)	compound (1-56')	compound (3-61)	5.4	8.1	2500.0	30.9	129.6
example (91)	compound (1-4')	compound (3-74)	5.1	9.8	2500.0	25.4	120.6
example (92)	compound (1-10')	compound (3-74)	5.2	9.8	2500.0	25.4	120.4
example (93)	compound (1-16')	compound (3-74)	5.2	9.6	2500.0	26.0	120.8
example (94)	compound (1-21')	compound (3-74)	5.4	9.4	2500.0	26.5	122.7
example (95)	compound (1-33')	compound (3-74)	5.5	9.5	2500.0	26.4	122.9
example (96)	compound (1-45')	compound (3-74)	5.0	9.6	2500.0	26.1	122.8
example (97)	compound (1-48')	compound (3-74)	5.0	9.2	2500.0	27.3	124.4
example (98)	compound (1-50')	compound (3-74)	5.4	9.0	2500.0	27.7	123.5
example (99)	compound (1-55')	compound (3-74)	5.3	9.0	2500.0	27.8	124.9
example (100)	compound (1-56')	compound (3-74)	5.5	9.2	2500.0	27.1	124.3

As can be seen from the results of Table 6, when the organic electric element material of the present invention represented by Formulas (1) and (2) is mixed and used as a phosphorescent host (Examples 1 to 100), it was confirmed that the driving voltage, efficiency, and life span were significantly improved as compared with the element (comparative examples 1 to 7) using a single material. More specifically, in Comparative Examples 1 to 7, wherein the compounds of the present invention represented by Formula (2) and comparative compounds 1 to 4 are used alone as a phosphorescent host, Comparative Examples 1 to 3 using the compounds (3-6, 3-61, and 3-74) of the present invention had higher efficiency and longer life span than Comparative Examples 4 to 7 using the comparative compound.

Also, Comparative Example 8 and 9 wherein Comparative Compound 1 and 2 or Comparative Compound 3 and 4 were mixed and used as a phosphorescent host were found to exhibit higher efficiency than Comparative Examples 1 to 7 using the single substance. Comparing Comparative Example 8 with 9, Comparative Example 9 using a mixture containing a polycyclic compound having a different heteroatom (N, S) among the 5-membered compounds had

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higher efficiency than Comparative Example 8 mixed a 5-membered heterocyclic compound having the same nitrogen atom. And it was confirmed that Example 1 to 100 using the mixture of the compound of Formula (1) and (2) as a host exhibited remarkably high efficiency and long life span than the Comparative Example 1 to 9.

On the basis of the above experimental results, the inventors of the present invention have found that, in the case of a mixture of the substance of Formulas (1) and (2), they have novel characteristics other than those for the respective materials, and have measured the PL lifetime using the substance of Formula (1), the substance of Formula (2), and the mixture of the present invention. As a result, it was confirmed that a new PL wavelength was formed when the compounds of Formulas (1) and (2) were mixed, and the decreasing and disappearing time of the newly formed PL wavelength increased from about 60 times to about 360 times compared to the reduction and disappearance times of substances Formula (1) and (2), respectively. It is considered when mixed with the compound of the present invention, not only electrons and holes are moved through the energy level of each substance, but also the efficiency and life span are

increased by electron, hole transport or energy transfer by a new region (exciplex) having a new energy level formed due to mixing. As a result, when the mixture of the present invention is used, the mixed thin film is an important example showing exciplex energy transfer and light emitting process.

The reason why the combination of the present invention is superior to Comparative Examples 8 to 9 in which a comparative compound is used as a phosphorescent host is that the high T1 and high LUMO energy values improve the electron blocking ability and allow more holes to be moved to the emitting layer more quickly and easily when a compound represented by Formula (1) having a strong hole property is mixed with a polycyclic compound represented by Formula (2), which is characterized not only by electron but also by hole stability and high T1. As a result, the charge balance in the emitting layer of holes and electrons is increased, so that light emission is well performed inside the emitting layer rather than at the interface of the hole transport layer, and therefore the deterioration in the HTL interface is also reduced, thereby maximizing the driving voltage, efficiency and life span of the device. Among the compounds represented by Formula (1), it has been confirmed that Dibenzofuran substituted compounds exhibits the best results in terms of the driving voltage, the efficiency and the lifetime, and Dibenzothiophen substituted compounds are also excellent in terms of efficiency due to their high refractive index. That is, it is concluded that the combination of Formula (1) and Formula (2) is electrochemically synergistic to improve the performance of the device as a whole.

Example 2) Manufacture and Evaluation of Red Organic Light Emitting Diode by Mixing Ratio

TABLE 7

First host	Second host	Mixing ratio (first host:second host)	Voltage	Current Density	Brightness (cd/m <sup>2</sup> )	Efficiency	Lifetime T (95)	
example compound (101)	compound (1-33')	compound (3-61)	2:8	5.5	8.5	2500.0	29.4	127.5
example compound (102)	compound (1-33')	compound (3-61)	3:7	5.5	8.3	2500.0	30.1	127.8
example compound (103)	compound (1-33')	compound (3-61)	4:6	5.7	8.8	2500.0	28.5	120.1
example compound (104)	compound (1-33')	compound (3-61)	5:5	5.8	9.4	2500.0	26.7	118.6
example compound (105)	compound (1-50')	compound (3-6)	2:8	5.4	7.3	2500.0	34.1	133.5
example compound (106)	compound (1-50')	compound (3-6)	3:7	5.3	7.2	2500.0	34.9	133.2
example compound (107)	compound (1-50')	compound (3-6)	4:6	5.5	7.6	2500.0	33.1	130.9
example compound (108)	compound (1-50')	compound (3-6)	5:5	5.8	7.7	2500.0	32.4	128.3

As shown in Table 7, the mixture of the compound of the present invention was measured by fabricating the device in (2:8, 3:7, 4:6, 5:5). To explain the results in detail, in the result of the mixture of the compound 1-54 and 3-6, the results of the driving voltage, the efficiency and the life span were similarly excellent at 2:8 and 3:7, but as the ratio of the first host increases, such as 4:6 and 5:5, the results of the driving voltage, the efficiency and the life span are gradually decreased, this was also the same in the result of the mixture of the compound 1-33' and 3-61. This can be explained by

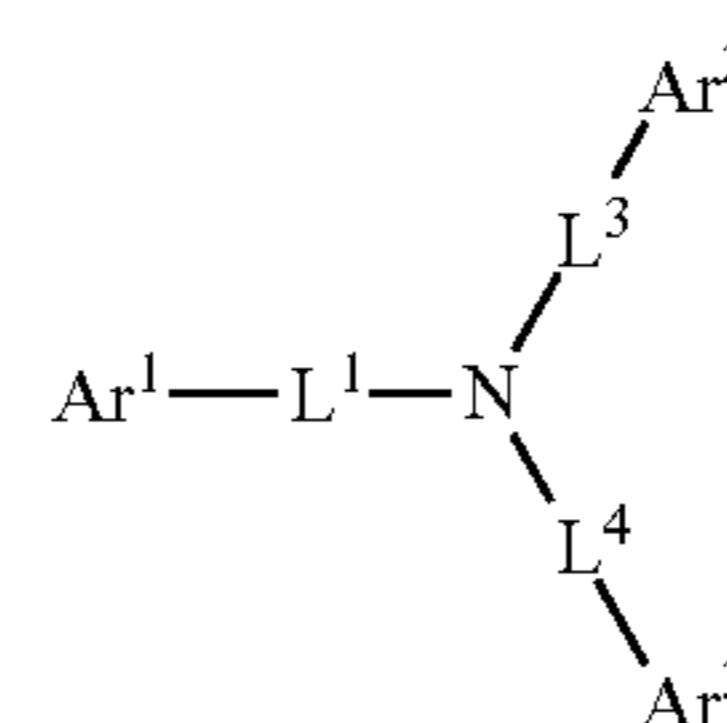
the fact that the charge balance in the emitting layer is maximized when an appropriate amount of the compound represented by Formula (1) having strong hole properties such as 2:8 and 3:7 is mixed.

Although exemplary embodiments of the present invention have been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims. Therefore, the embodiment disclosed in the present invention is intended to illustrate the scope of the technical idea of the present invention, and the scope of the present invention is not limited by the embodiment.

The scope of the present invention shall be construed on the basis of the accompanying claims, and it shall be construed that all of the technical ideas included within the scope equivalent to the claims belong to the present invention.

What is claimed is:

1. An organic electric element comprising a first electrode, a second electrode, and an organic material layer formed between the first electrode and the second electrode, wherein the organic material layer comprises an emitting layer, and the emitting layer is a phosphorescent light emitting layer and comprises a first host compound represented by Formula (1) and a second host compound represented by Formula (2):

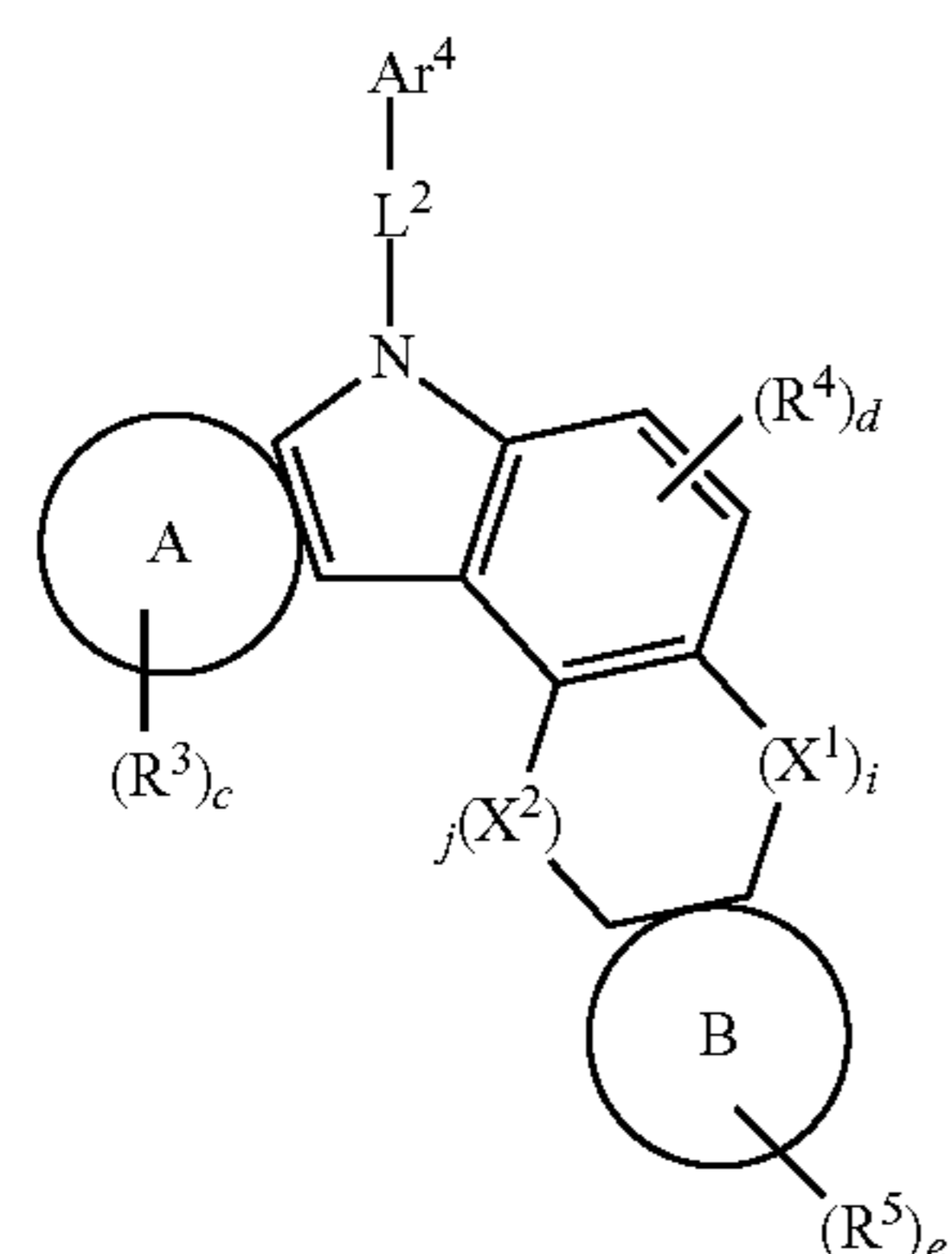


Formula (1)



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Formula (2)

wherein:

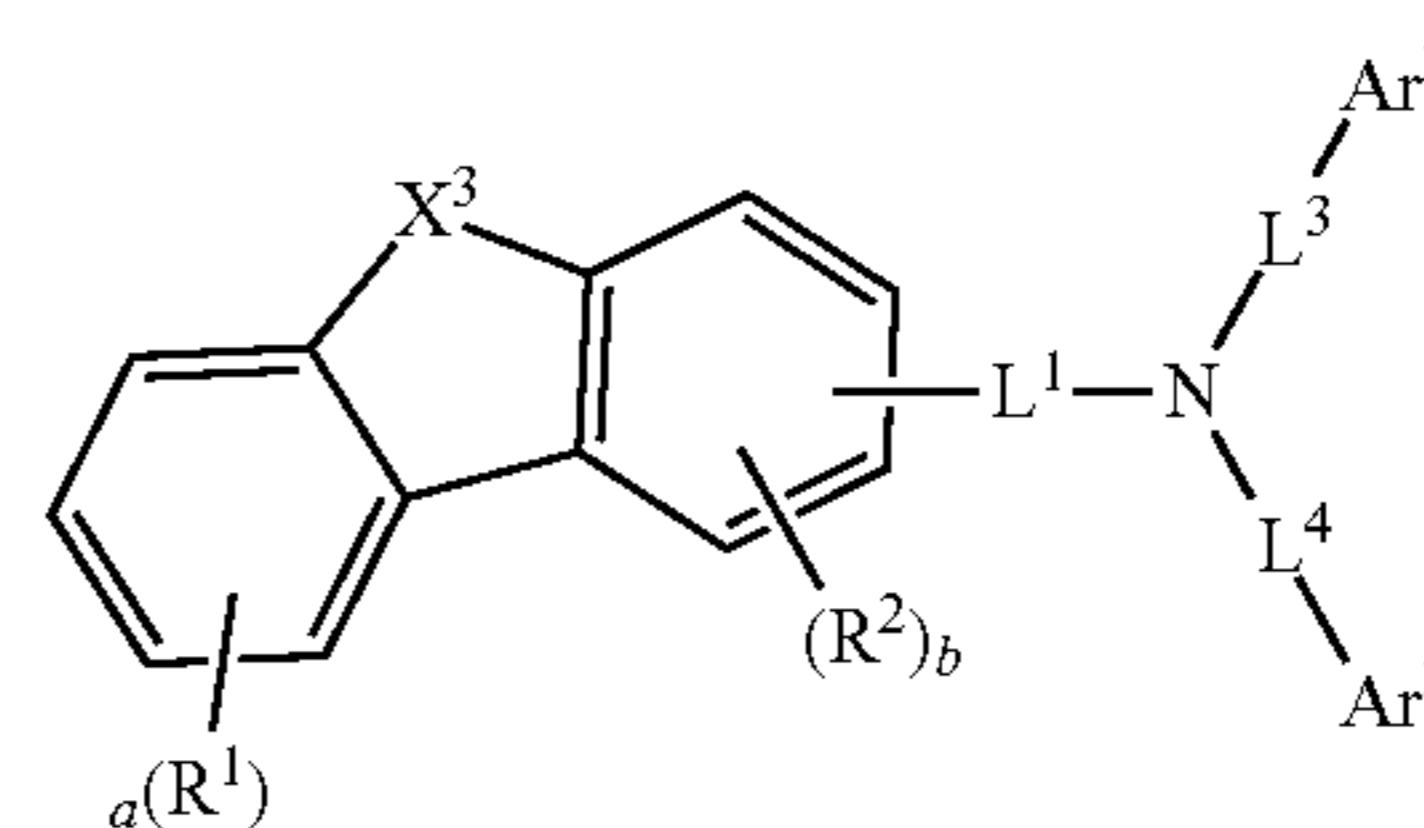
- 1)  $Ar^1$ ,  $Ar^2$ ,  $Ar^3$  and  $Ar^4$  are each independently selected from the group consisting of a  $C_6-C_{60}$  aryl group; a fluorenyl group; a  $C_2-C_{60}$  heterocyclic group including at least one hetero atom of O, N, S, Si and P; a fused ring group of a  $C_3-C_{60}$  aliphatic ring and a  $C_6-C_{60}$  aromatic ring; a  $C_1-C_{50}$  alkyl group; a  $C_2-C_{20}$  alkenyl group; a  $C_2-C_{20}$  alkynyl group; a  $C_1-C_{30}$  alkoxy group; a  $C_6-C_{30}$  aryloxy group;
- 2)  $c$  and  $e$  are integer of 0 to 10,  $d$  is an integer of 0 to 2, and  $R^3$ ,  $R^4$  and  $R^5$  are the same or different from each other and are each independently selected from the group consisting of deuterium; halogen; a  $C_6-C_{60}$  aryl group; a fluorenyl group; a  $C_2-C_{60}$  heterocyclic group including at least one heteroatom of O, N, S, Si and P; a fused ring group of a  $C_3-C_{60}$  aliphatic ring and a  $C_6-C_{60}$  aromatic ring; a  $C_1-C_{50}$  alkyl group; a  $C_2-C_{20}$  alkenyl group; a  $C_2-C_{20}$  alkynyl group; a  $C_1-C_{30}$  alkoxy group; a  $C_6-C_{30}$  aryloxy group; and  $-L'-N(R_a)(R_b)$ , wherein,  $L'$  is selected from the group consisting of a single bond; a  $C_6-C_{60}$  arylene group; a fluorenylene group; a fused ring group of a  $C_3-C_{60}$  aliphatic ring and a  $C_6-C_{60}$  aromatic ring; and a  $C_2-C_{60}$  heterocyclic, and  $R_a$  and  $R_b$  are independently selected from the group consisting of a  $C_6-C_{60}$  aryl group; a fluorenyl group; a fused ring group of a  $C_3-C_{60}$  aliphatic ring and a  $C_6-C_{60}$  aromatic ring; and a  $C_2-C_{60}$  heterocyclic group containing at least one hetero atom of O, N, S, Si and P, or in case  $c$ ,  $d$  and  $e$  are 2 or more,  $R^3$ ,  $R^4$  and  $R^5$  are each in plural being the same or different and a plurality of  $R^3$  or a plurality of  $R^4$  or a plurality of  $R^5$  combine to each other to form a ring,
- 3)  $L^1$ ,  $L^2$ ,  $L^3$  are  $L^4$  each independently selected from the group consisting of a single bond; a  $C_6-C_{60}$  arylene group; and a fluorenylene group; a fused ring group of a  $C_3-C_{60}$  aliphatic ring and a  $C_6-C_{60}$  aromatic ring; and a  $C_2-C_{60}$  heterocyclic group;
- 4)  $A$  and  $B$  are each independently a  $C_6-C_{60}$  aryl group or a  $C_2-C_{20}$  heterocyclic group, wherein in case both  $A$  and  $B$  are a substituted or unsubstituted  $C_6$  aryl group (phenyl group),  $d$  is 2, and  $R^4$ 's are bonded to each other to form a ring to form an aromatic or hetero ring,
- 5)  $i$  and  $j$  are independently 0 or 1, with the proviso that  $i+j$  is 1 or more, and when  $i$  or  $j$  is 0, it means a direct bond,
- 6)  $X^1$  and  $X^2$  are independently  $NR'$ , O, S, or  $CR''$ , wherein  $R'$  and  $R''$  are independently hydrogen; a  $C_6-C_{60}$  aryl group; a fluorenyl group; a  $C_3-C_{60}$  hetero-

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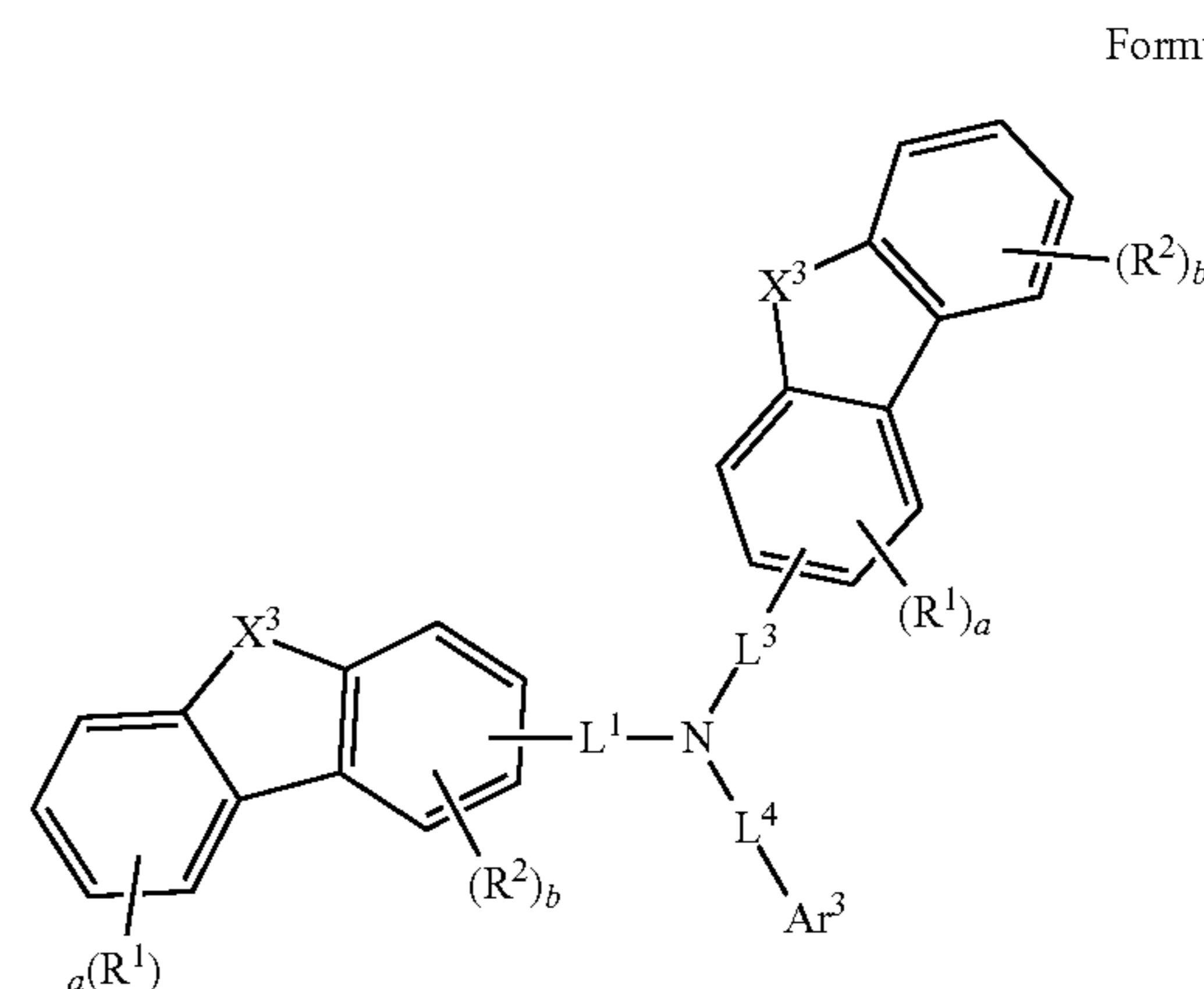
cyclic group; or a  $C_1-C_{50}$  alkyl group, and  $R'$  and  $R''$  may combine to each other to form a spiro ring,

wherein, the aryl group, fluorenyl group, arylene group, heterocyclic group, fused ring group, alkyl group, alkenyl group, alkoxy group and aryloxy group may be substituted with one or more substituents selected from the group consisting of deuterium; halogen; a silane group substituted or unsubstituted with  $C_1-C_{20}$  alkyl group or  $C_6-C_{20}$  aryl group; siloxane group; boron group; germanium group; cyano group; nitro group;  $-L'-N(R_a)(R_b)$ ; a  $C_1-C_{20}$  alkylthio group;  $C_1-C_{20}$  alkoxy group;  $C_1-C_{20}$  alkyl group;  $C_2-C_{20}$  alkenyl group;  $C_2-C_{20}$  alkynyl group;  $C_6-C_{20}$  aryl group;  $C_6-C_{20}$  aryl group substituted with deuterium; a fluorenyl group;  $C_2-C_{20}$  heterocyclic group;  $C_3-C_{20}$  cycloalkyl group;  $C_7-C_{20}$  arylalkyl group; and  $C_8-C_{20}$  arylalkenyl group; wherein the substituents may combine each other and form a saturated or unsaturated ring, wherein the term 'ring' means  $C_3-C_{60}$  aliphatic ring or  $C_6-C_{60}$  aromatic ring or a  $C_2-C_{60}$  heterocyclic ring or a fused ring formed by the combination of thereof.

2. The organic electric element according to claim 1, wherein the first host compound represented by Formula (1) is represented by any one of the following Formulas (3) to (5):



Formula (3)

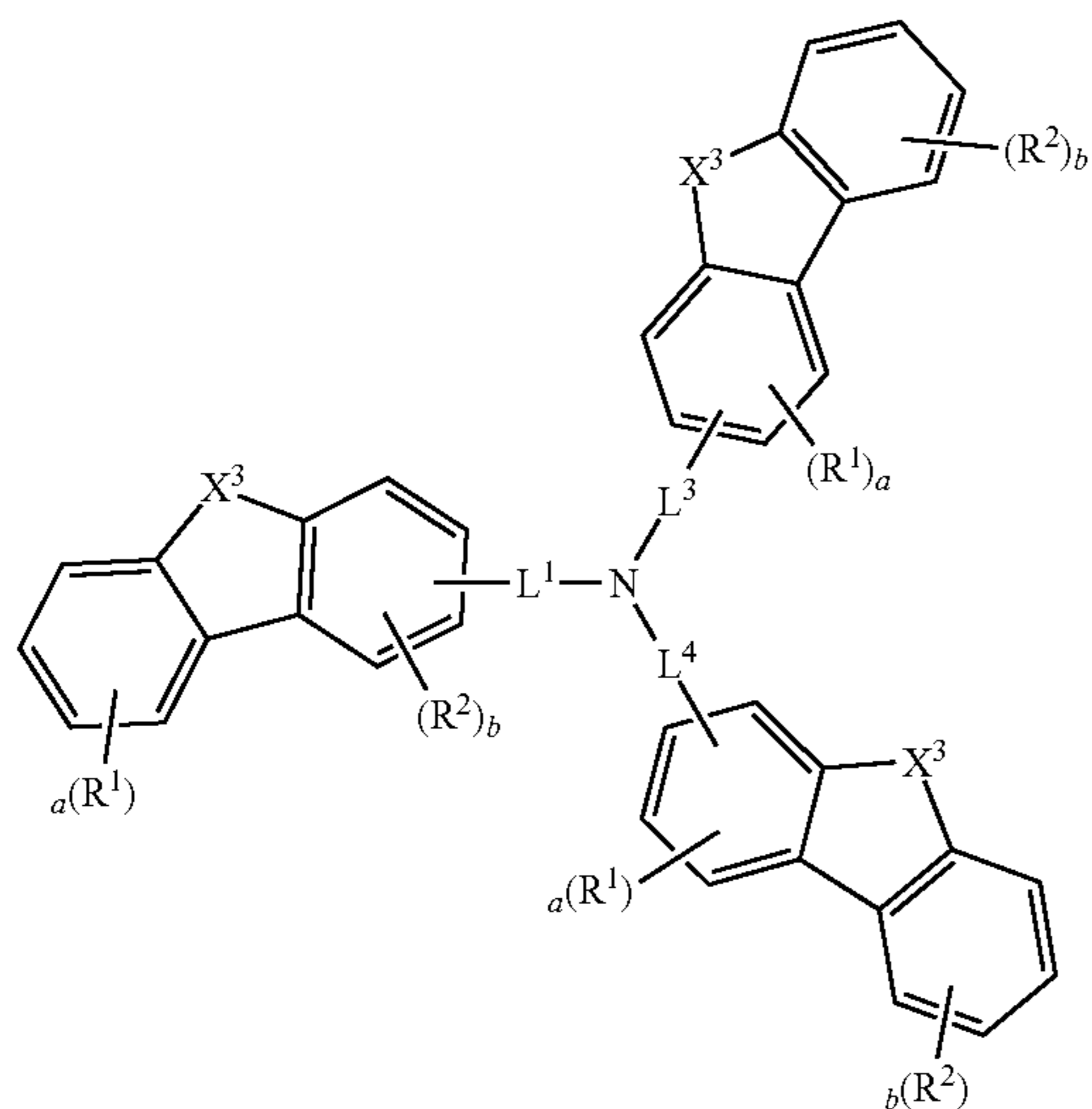


Formula (4)

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Formula (5)



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wherein:

1) L<sup>1</sup>, L<sup>3</sup>, L<sup>4</sup>, Ar<sup>2</sup> and Ar<sup>3</sup> are the same as defined in Formula (1),

2) X<sup>3</sup> is O or S,

3) a is an integer of 0 to 4, b is an integer of 0 to 3, and R<sup>1</sup> and R<sup>2</sup> are the same or different from each other, and are each independently selected from the group consisting of deuterium; halogen; a C<sub>6</sub>-C<sub>60</sub> aryl group; a fluorenyl group; a C<sub>2</sub>-C<sub>60</sub> heterocyclic group including at least one heteroatom of O, N, S, Si and P; a fused ring group of a C<sub>3</sub>-C<sub>60</sub> aliphatic ring and a C<sub>6</sub>-C<sub>60</sub> aromatic ring; a C<sub>1</sub>-C<sub>50</sub> alkyl group; a C<sub>2</sub>-C<sub>20</sub> alkenyl group; a C<sub>2</sub>-C<sub>20</sub> alkynyl group; a C<sub>1</sub>-C<sub>30</sub> alkoxy group; a C<sub>6</sub>-C<sub>30</sub> aryloxy group; and —L<sup>1</sup>-N(R<sub>a</sub>)(R<sub>b</sub>); or in case a and b are 2 or more, R<sup>1</sup> and R<sup>2</sup> are each in plural being the same or different, and a plurality of R<sup>1</sup> or a plurality of R<sup>2</sup> combine to each other to form a ring.

3. The organic electric element according to claim 1, wherein the compound represented by Formula (1) is represented by any one of the following Formulas (6) to (14):

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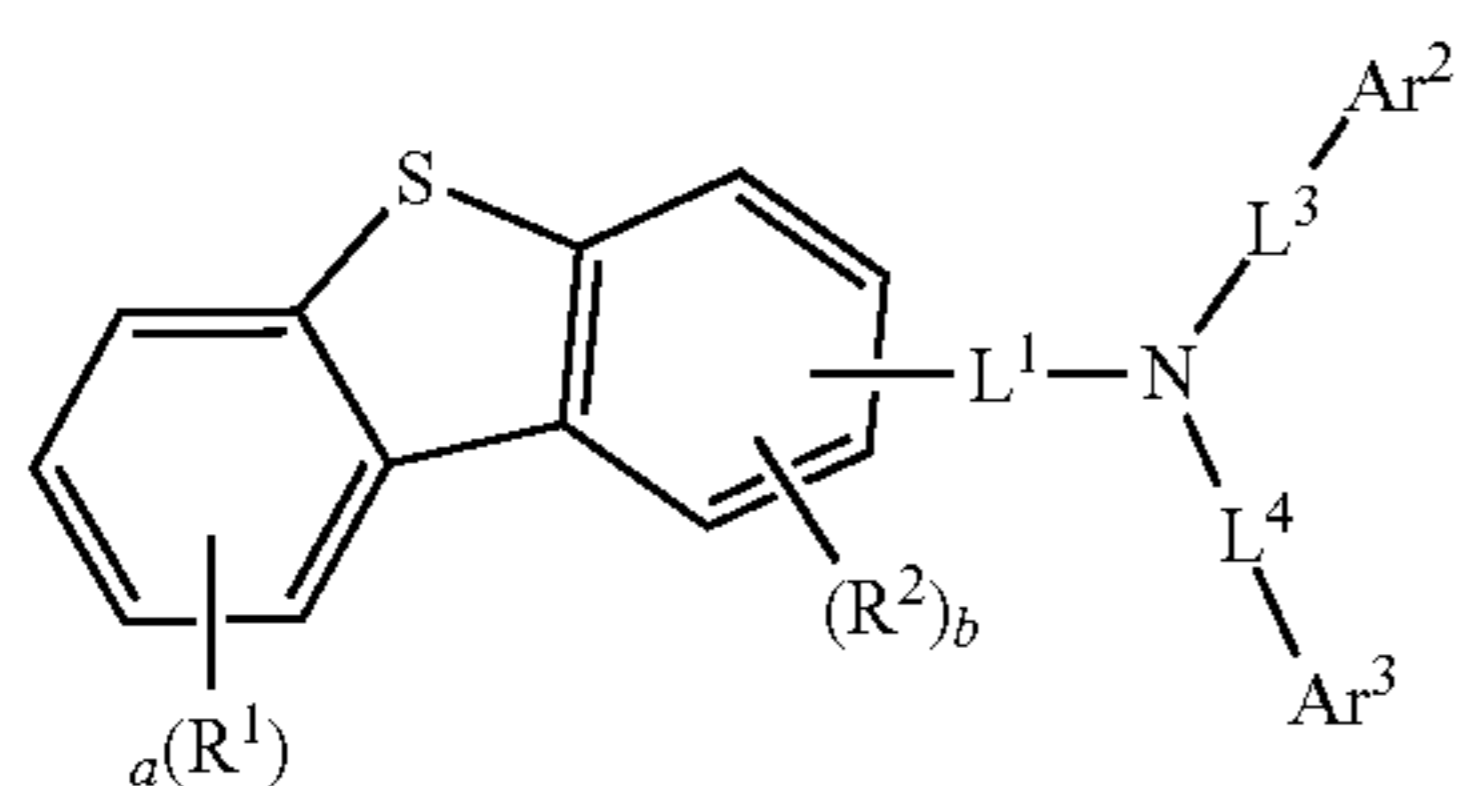
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Formula (6)



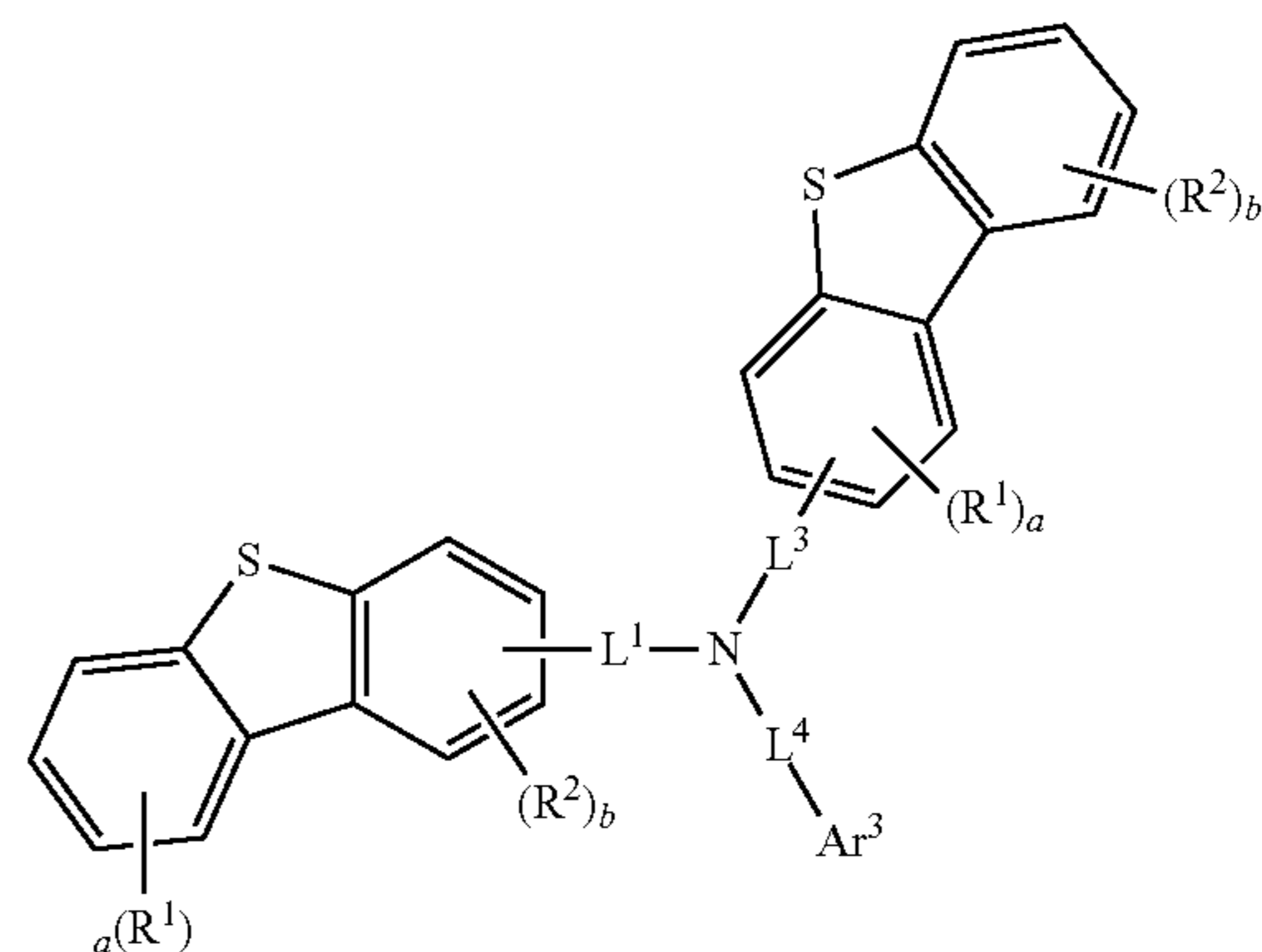
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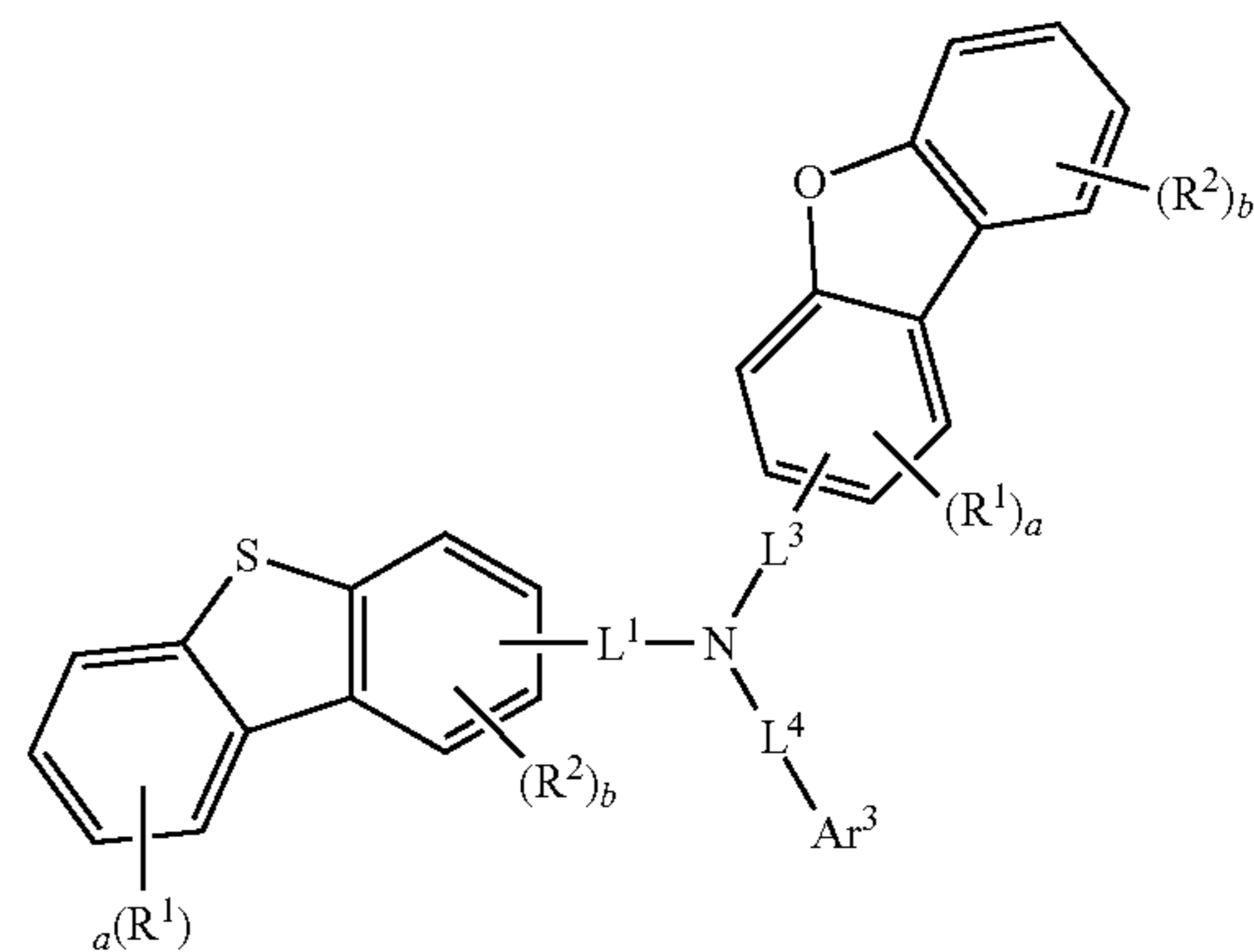
174

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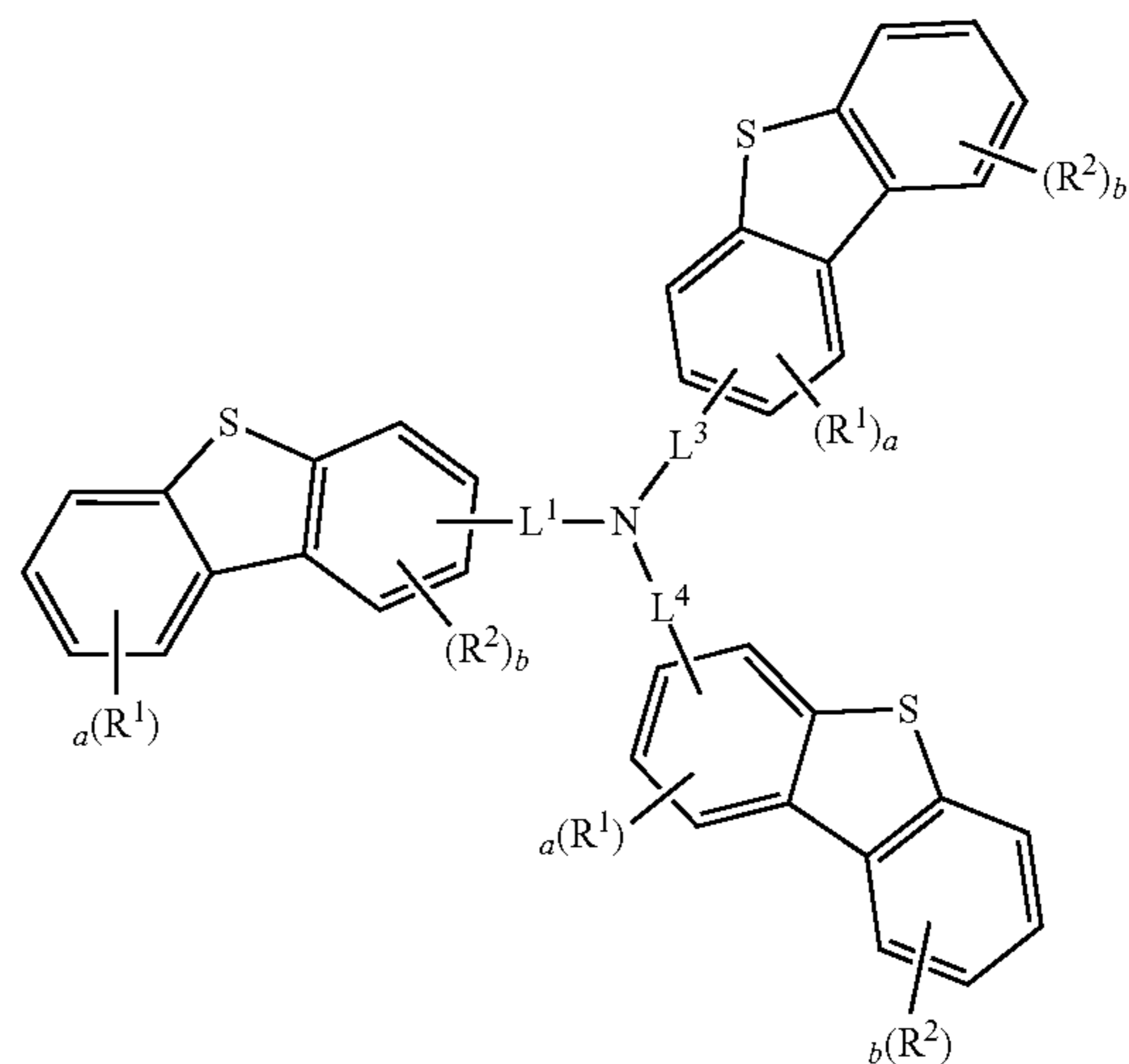
Formula (7)



Formula (8)



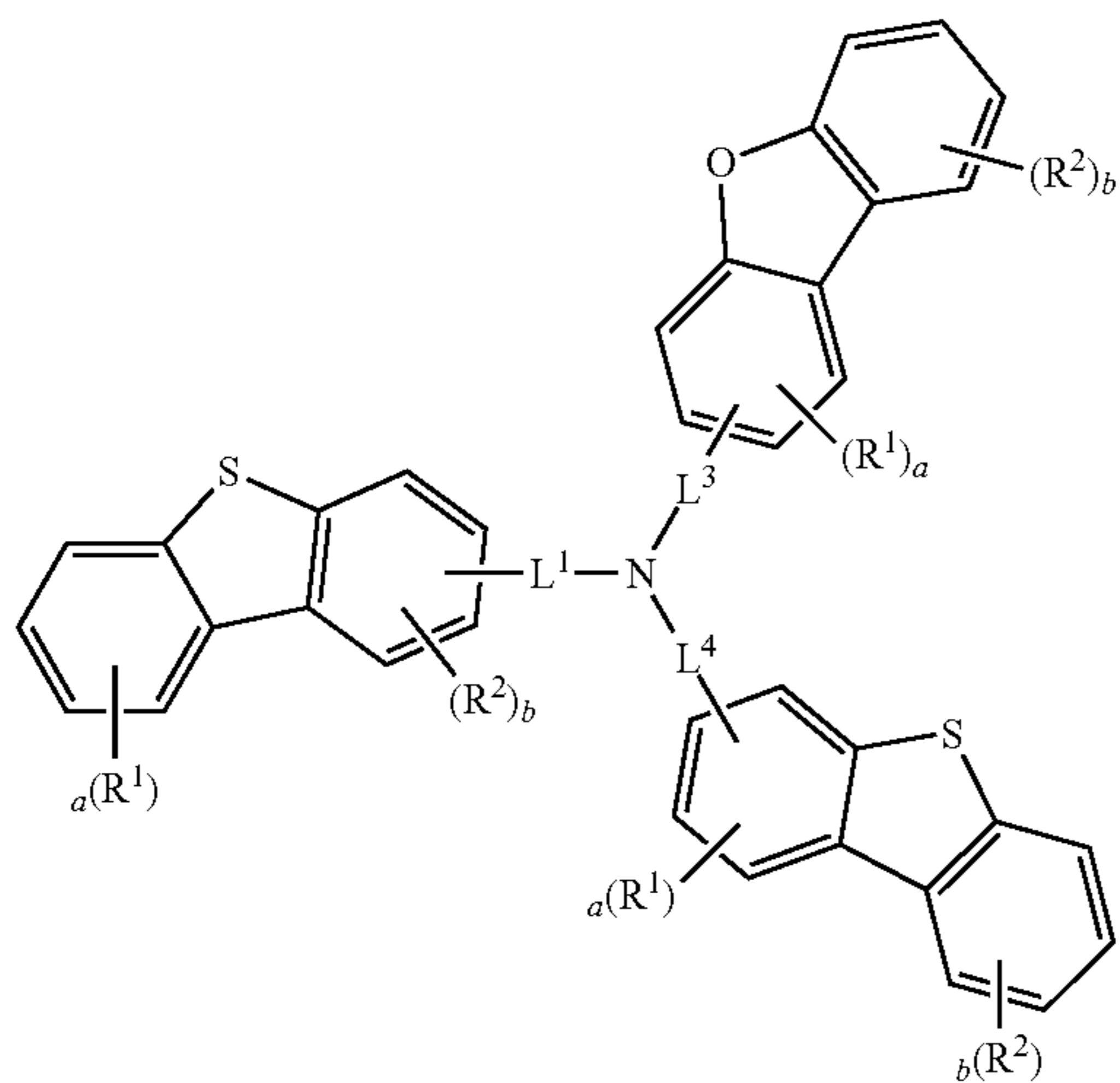
Formula (9)



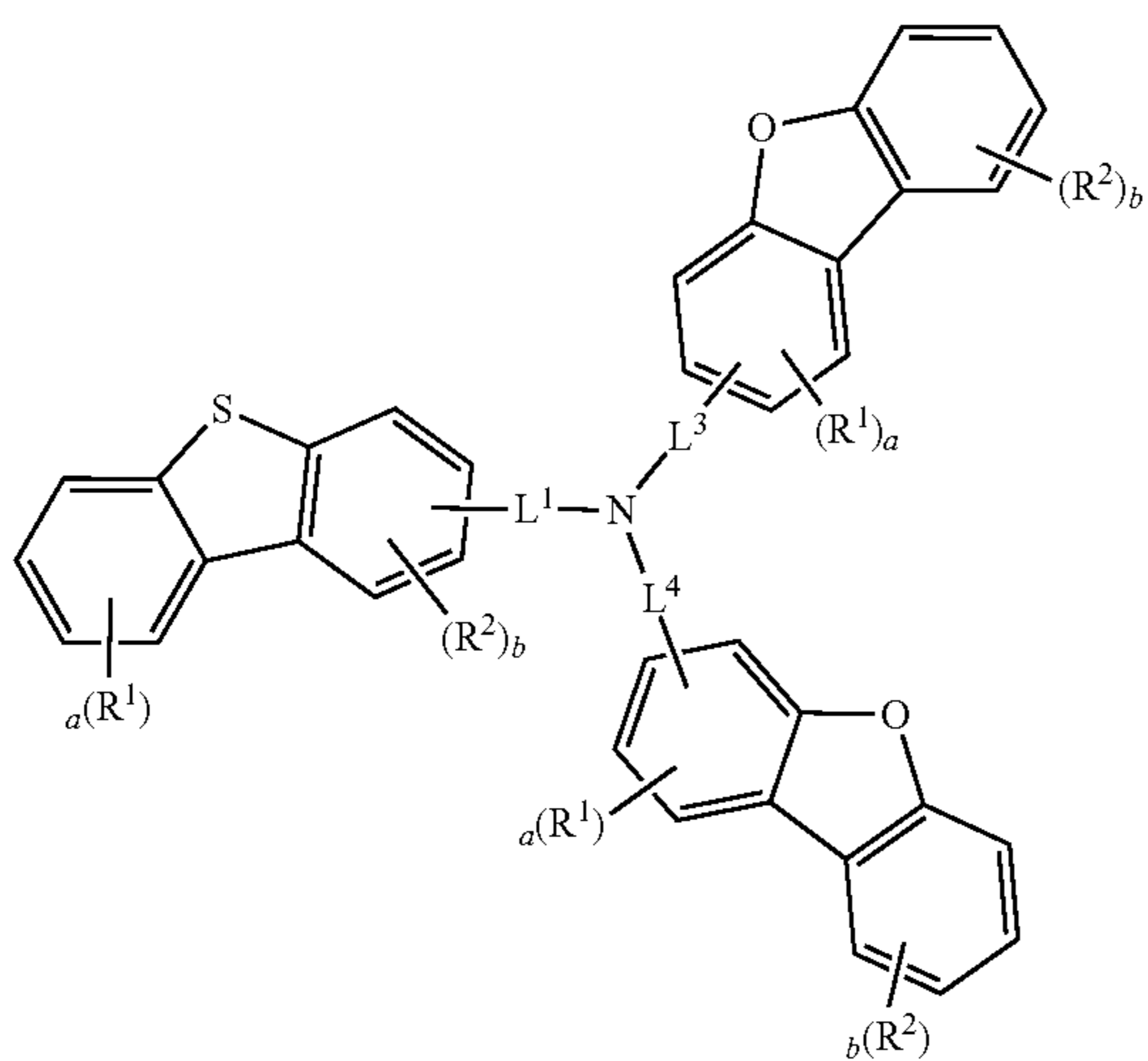
175

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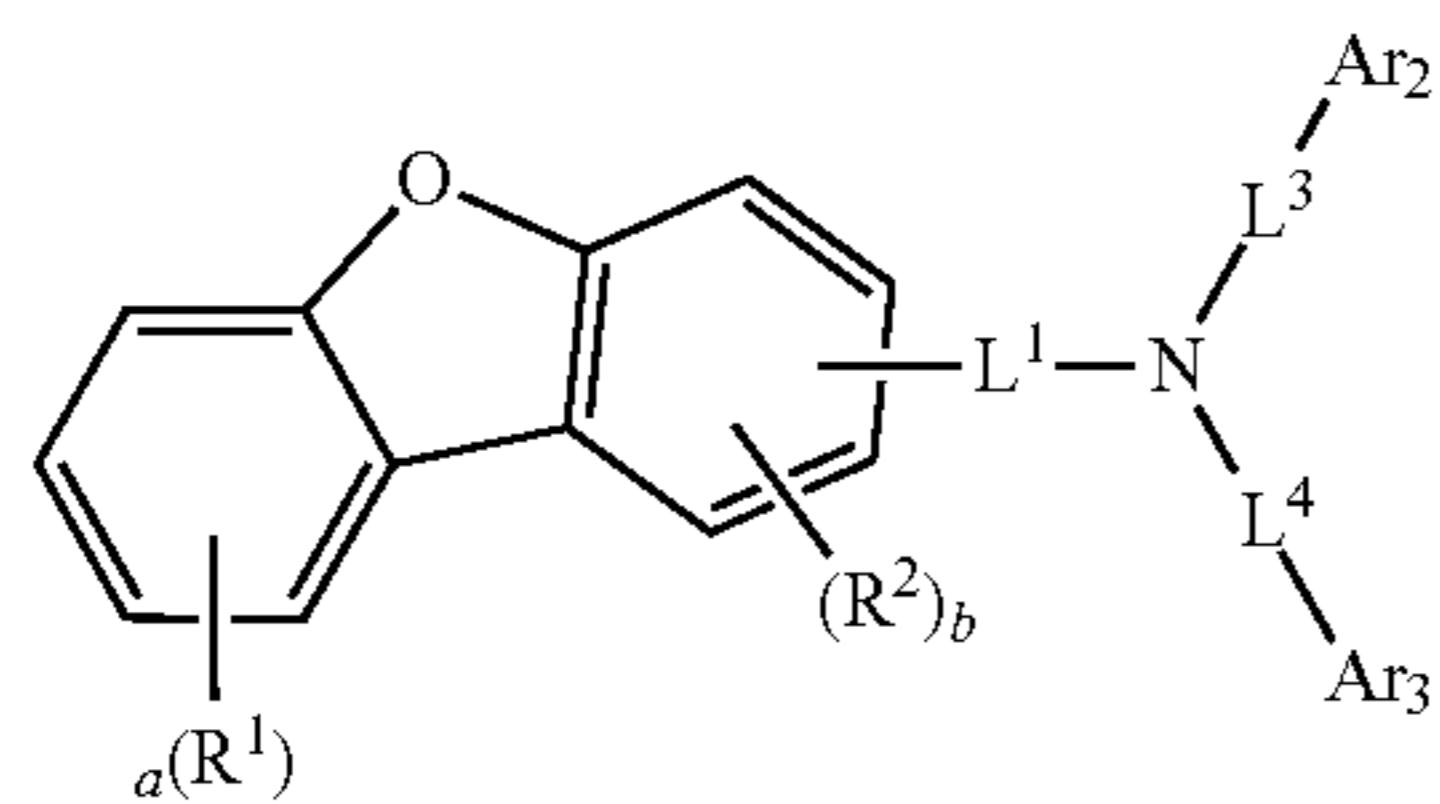
Formula (10)



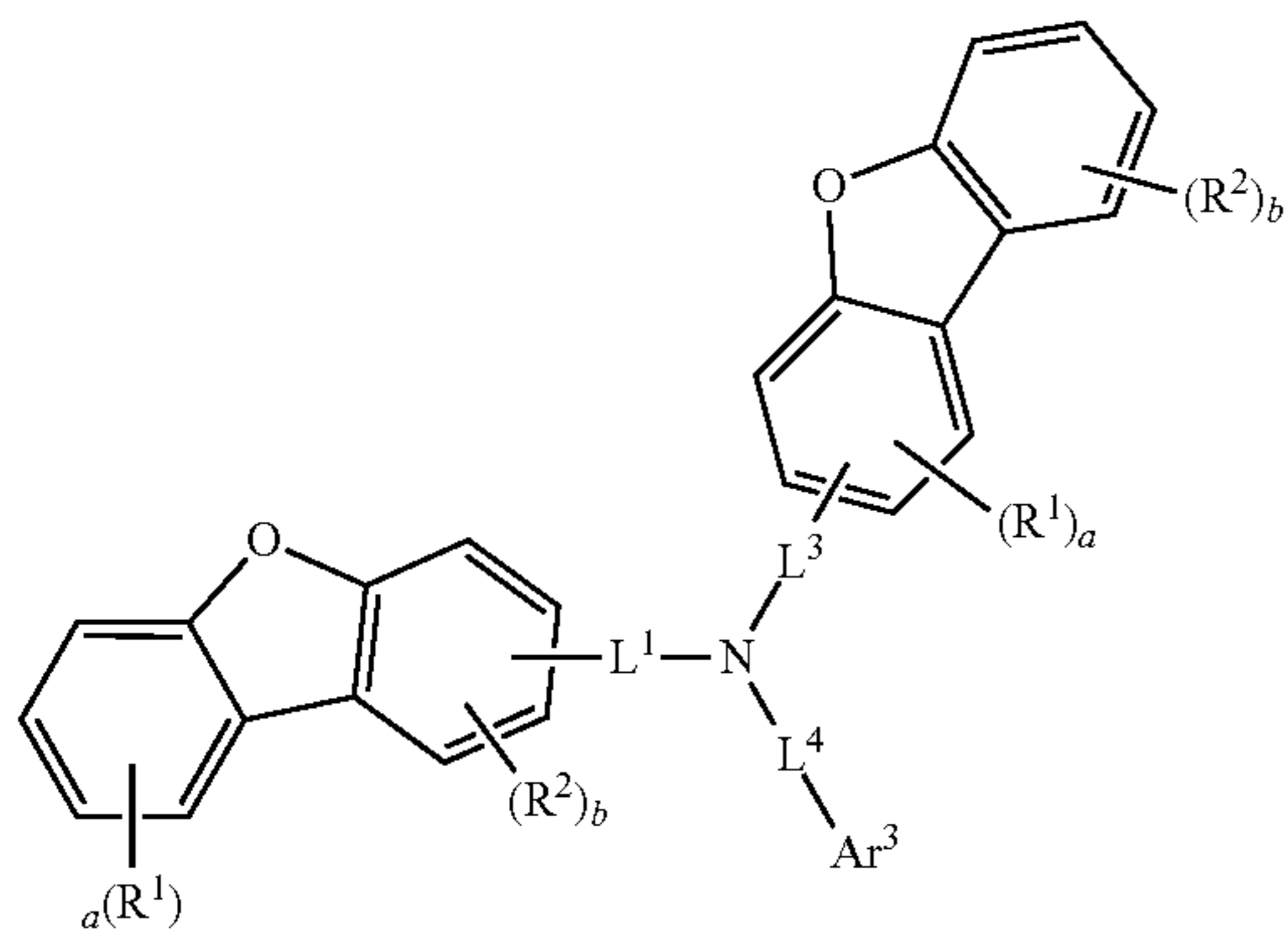
Formula (11)



Formula (12)



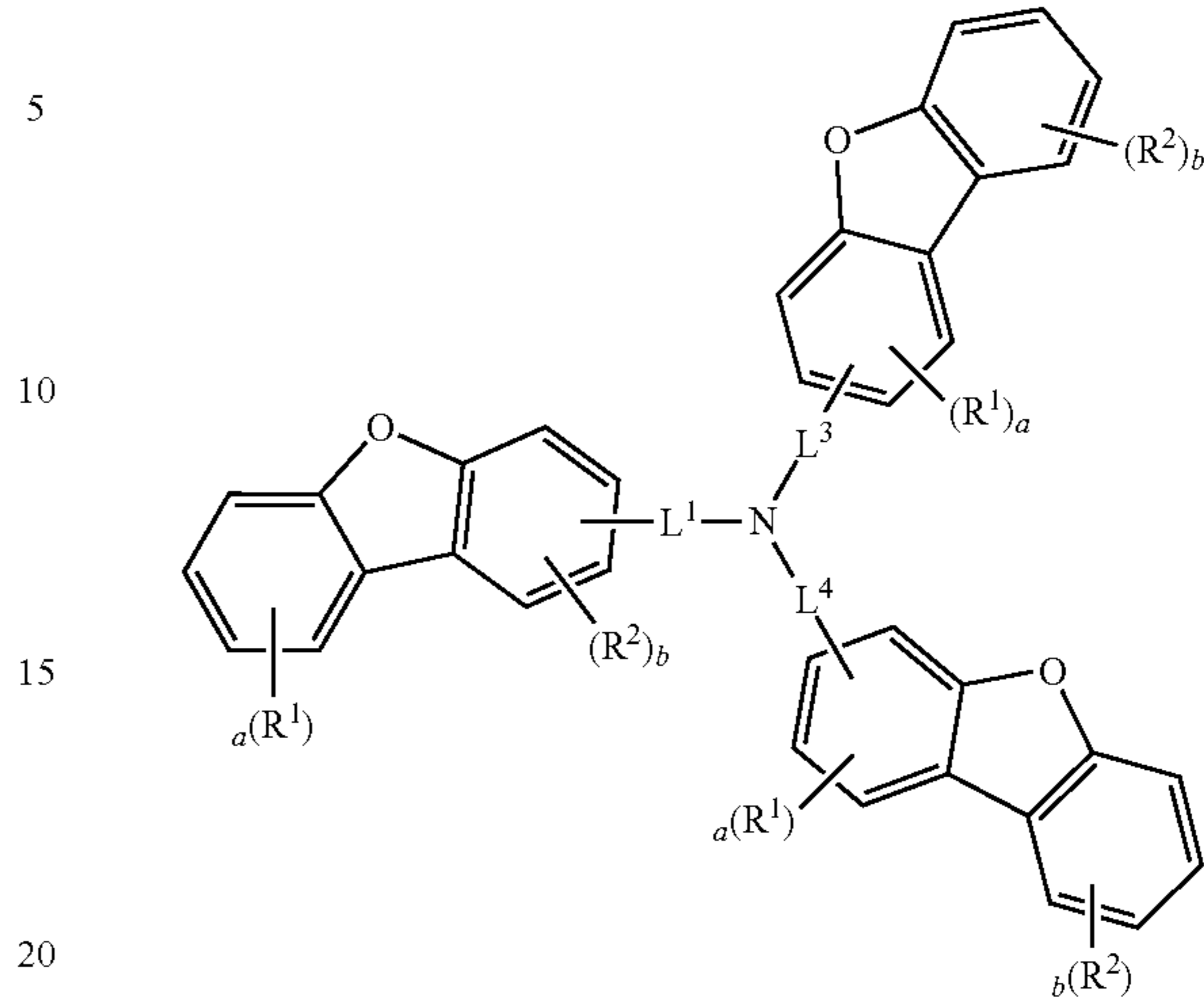
Formula (13)



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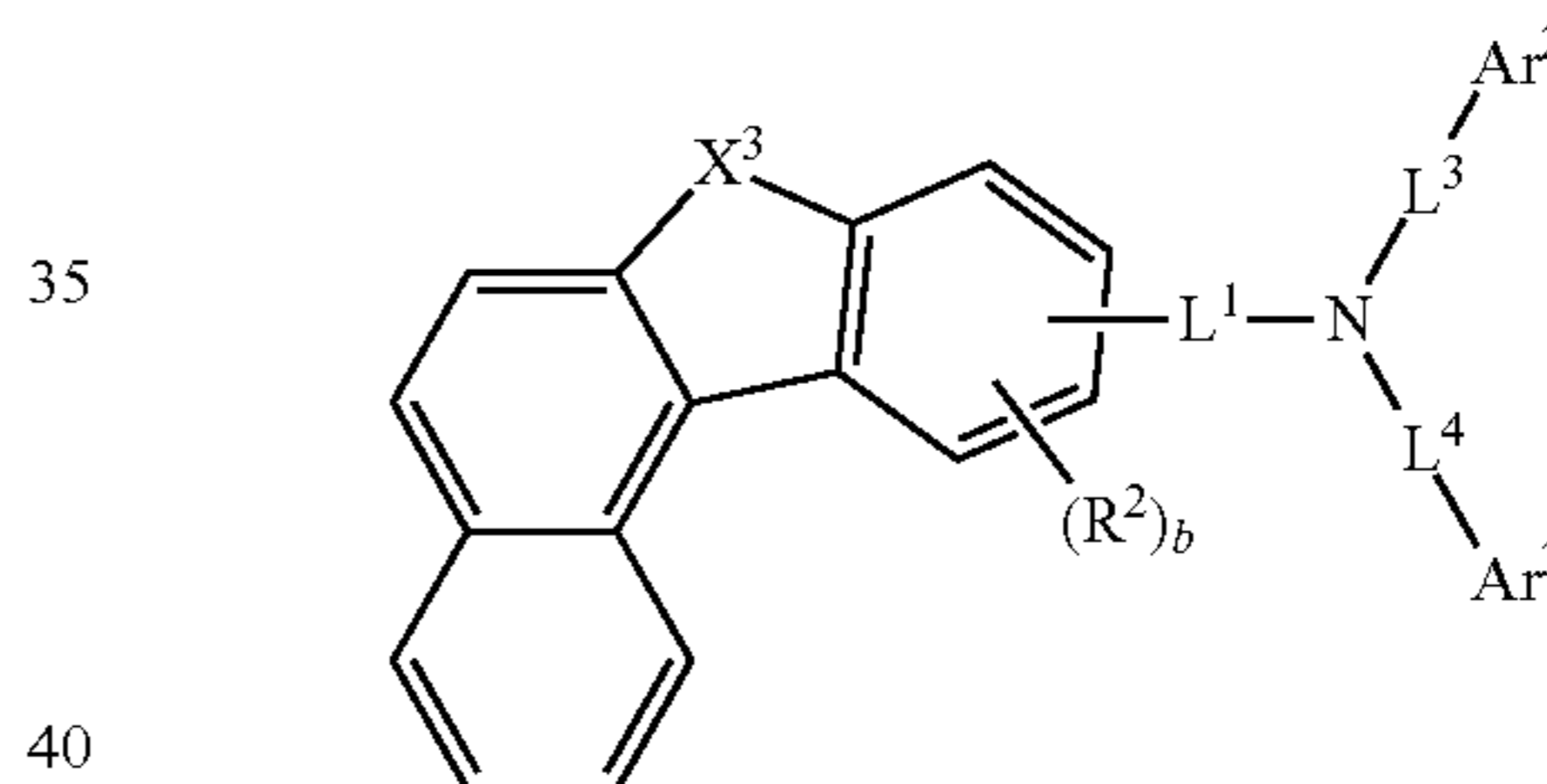
Formula (14)



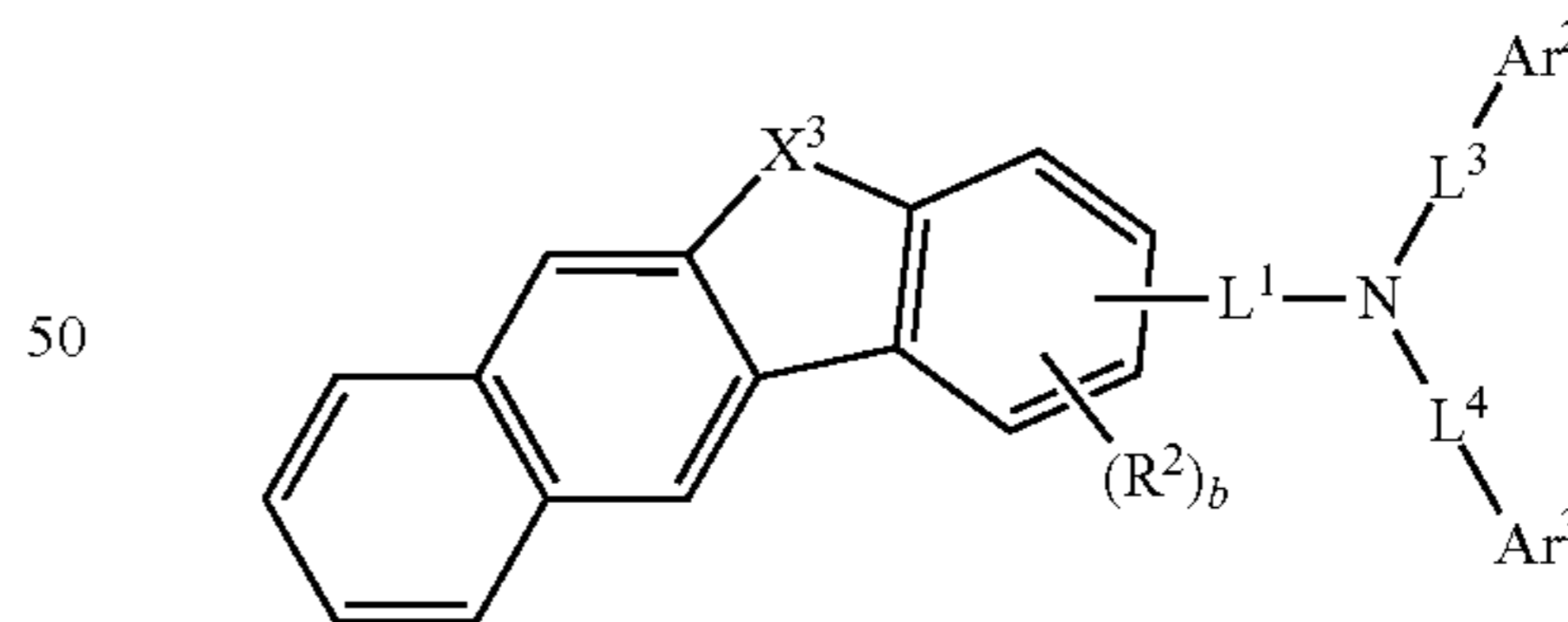
wherein L<sup>1</sup>, L<sup>3</sup>, L<sup>4</sup>, Ar<sup>2</sup>, Ar<sup>3</sup>, R<sup>1</sup>, R<sup>2</sup>, a and b are the same as defined in claim 2.

4. The organic electric element according to claim 1, wherein the first host compound represented by Formula (1) is represented by any one of the following Formulas (15) to (23):

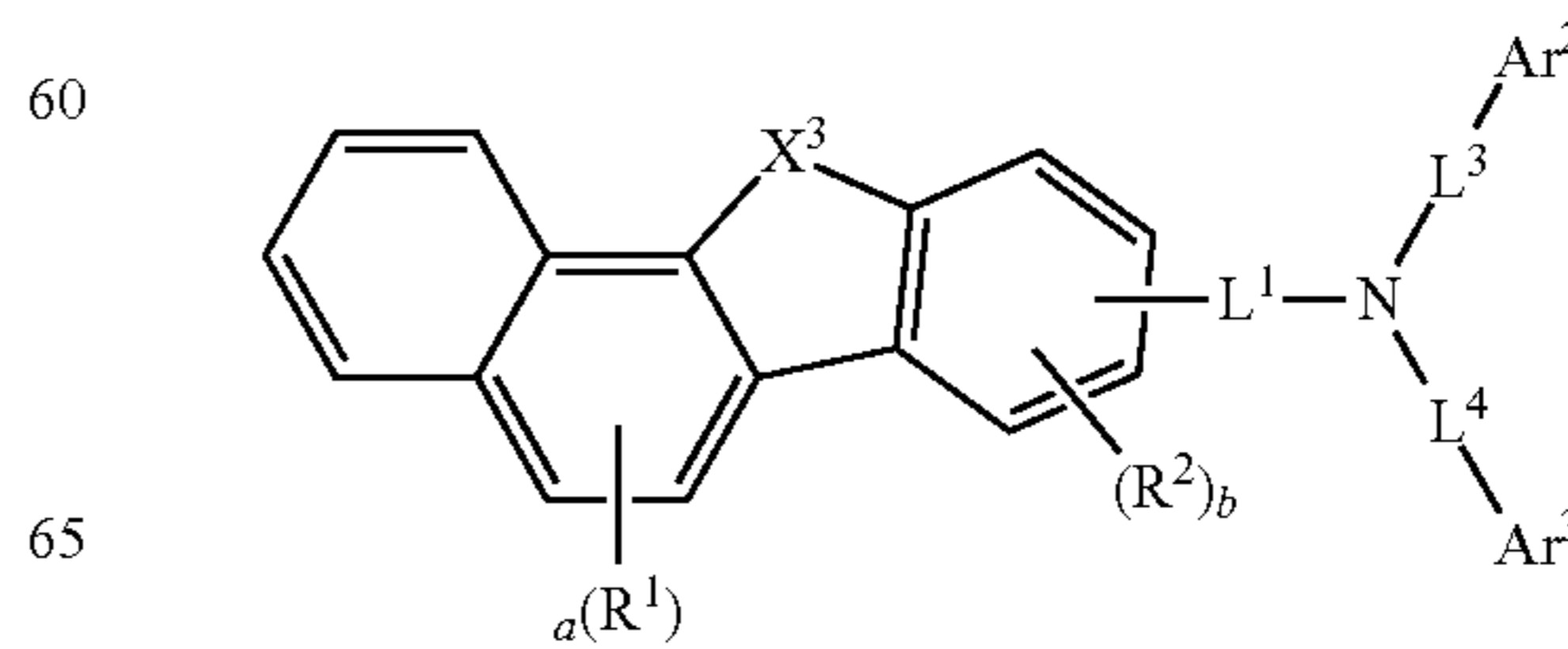
Formula (15)



Formula (16)

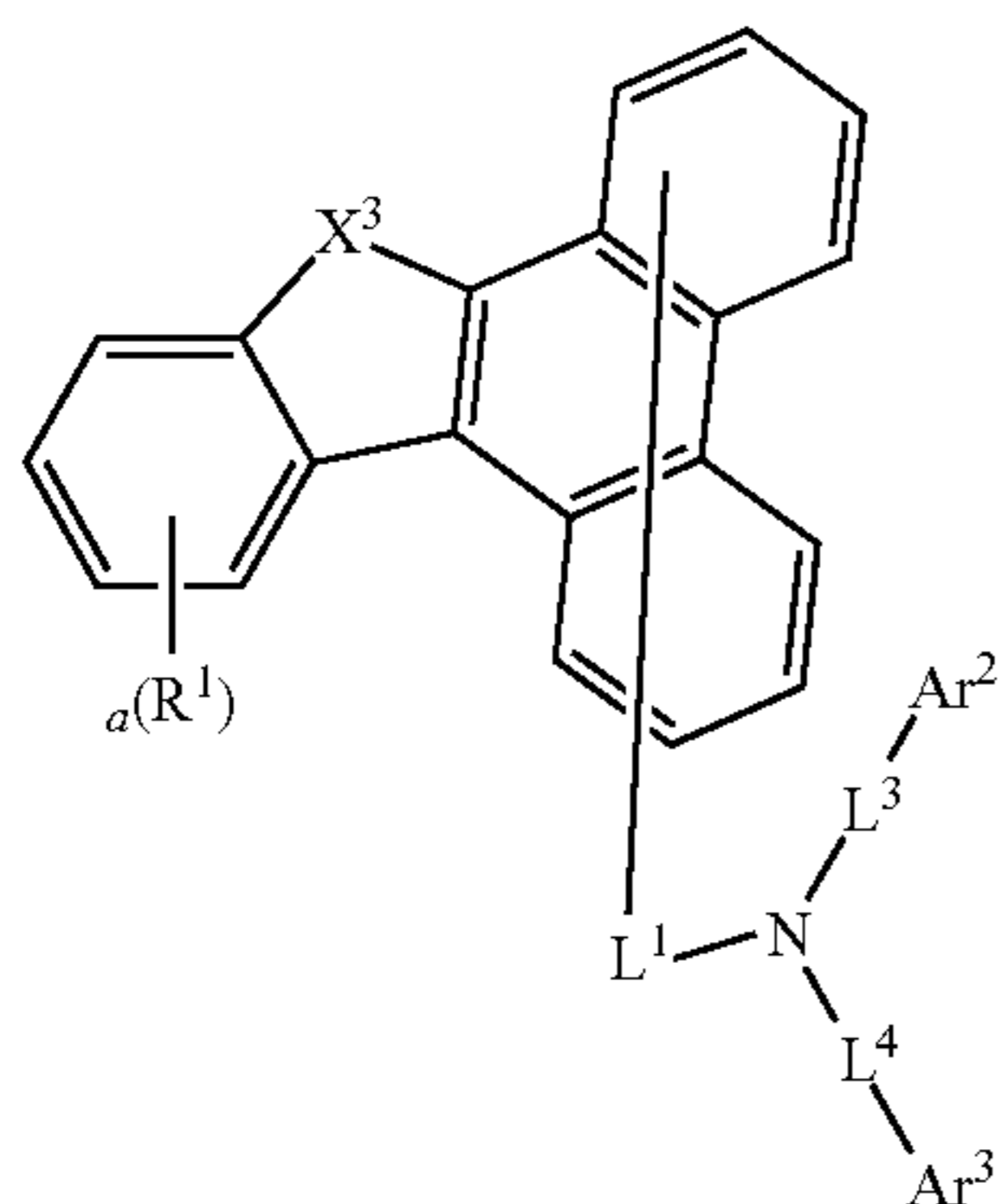
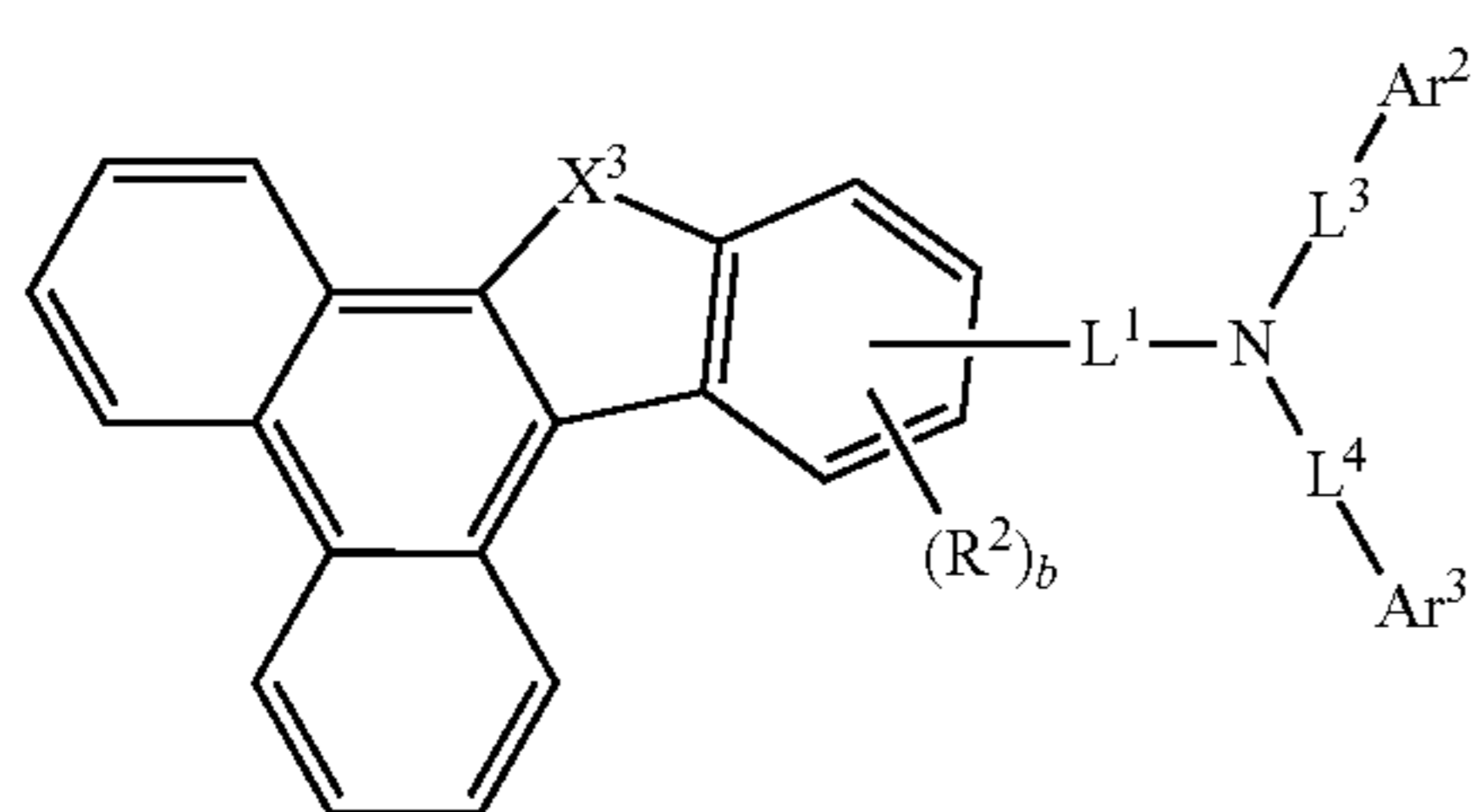
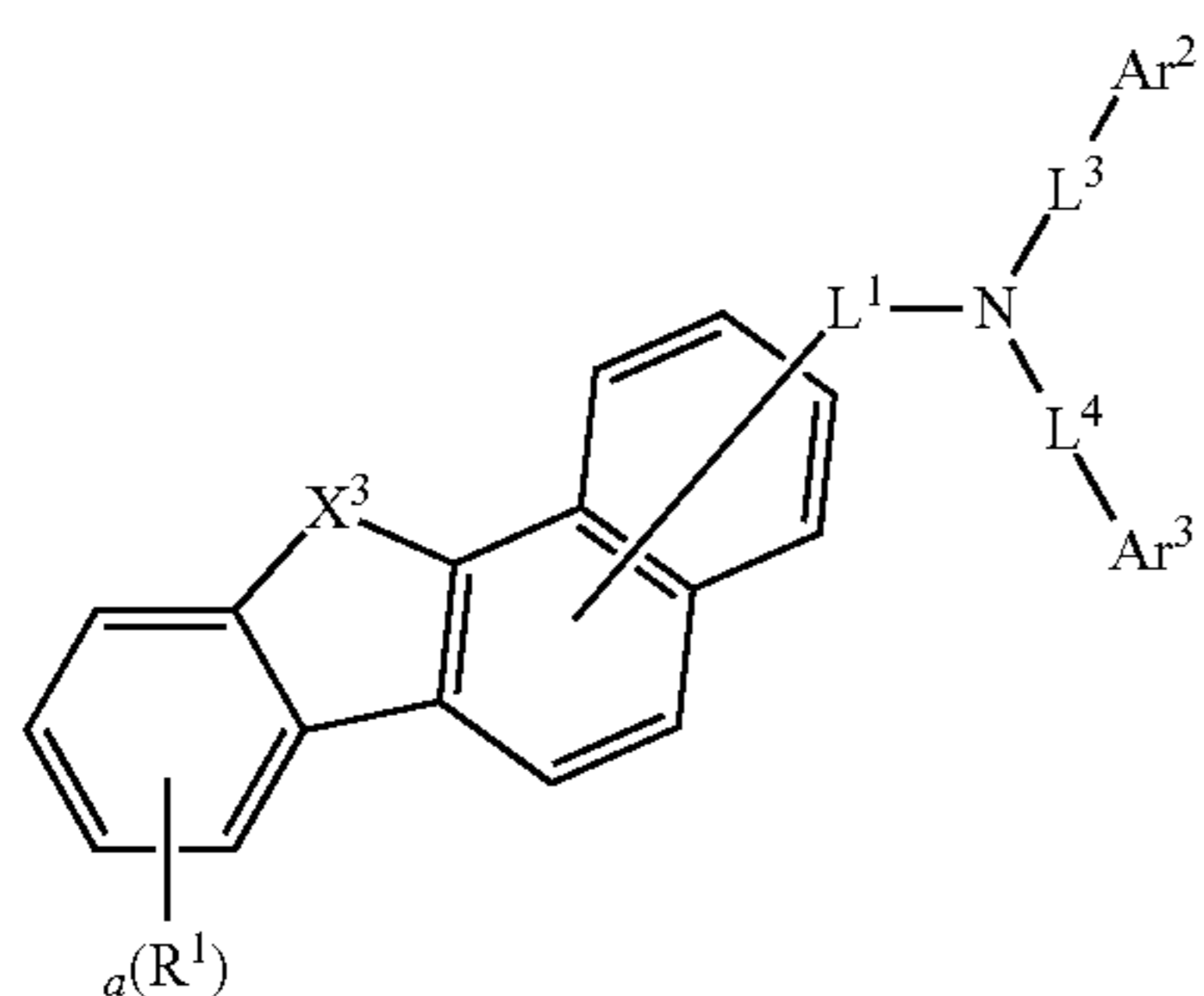
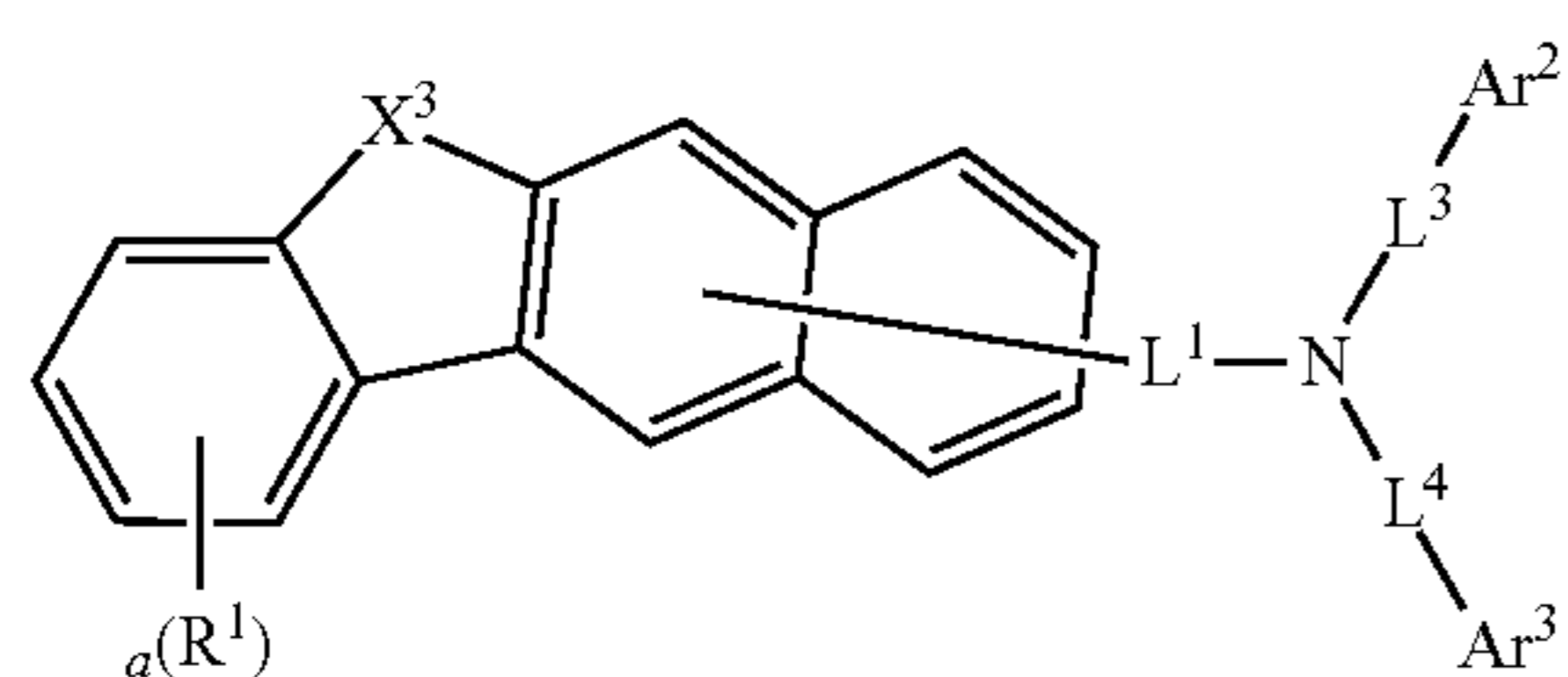
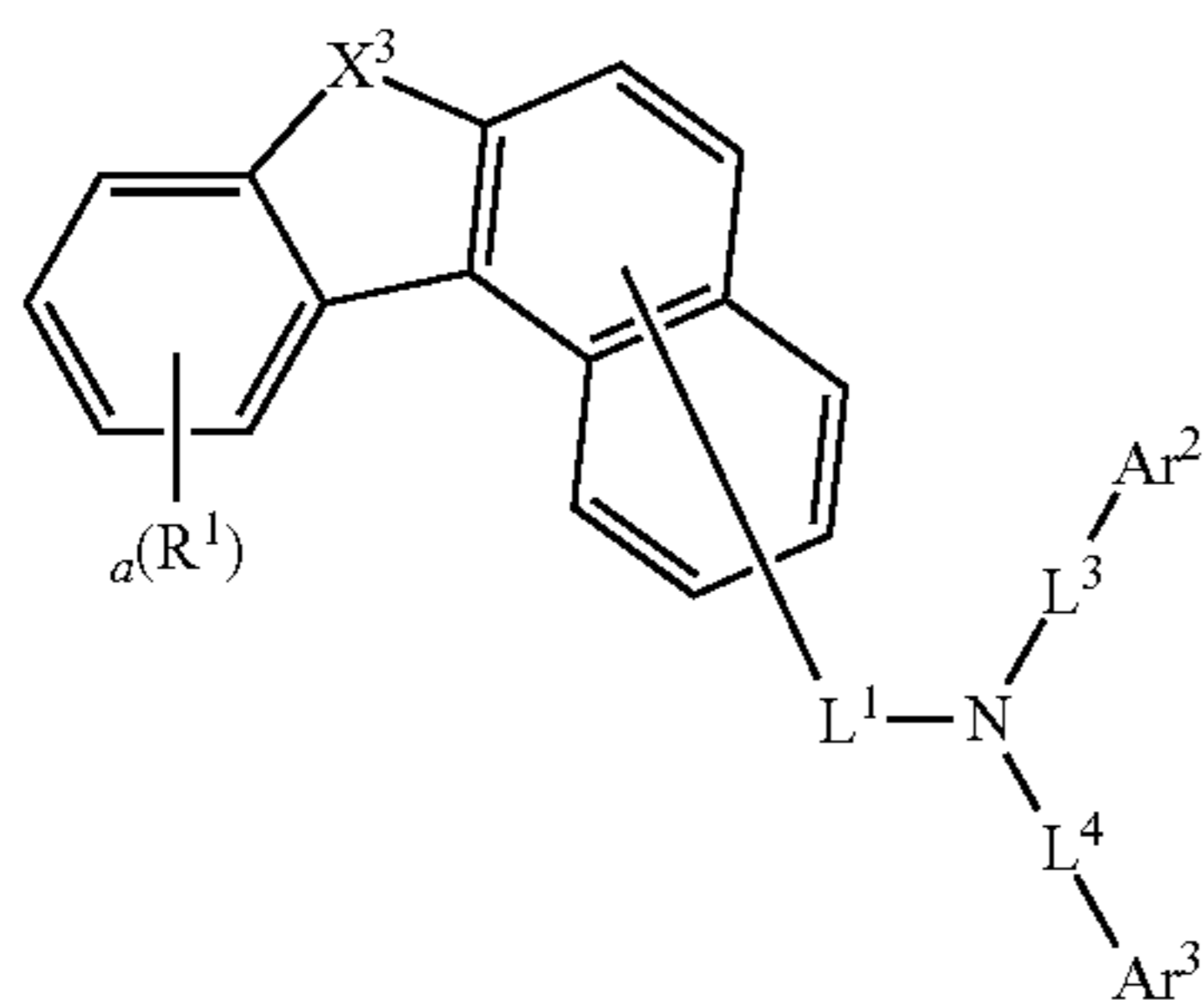


Formula (17)



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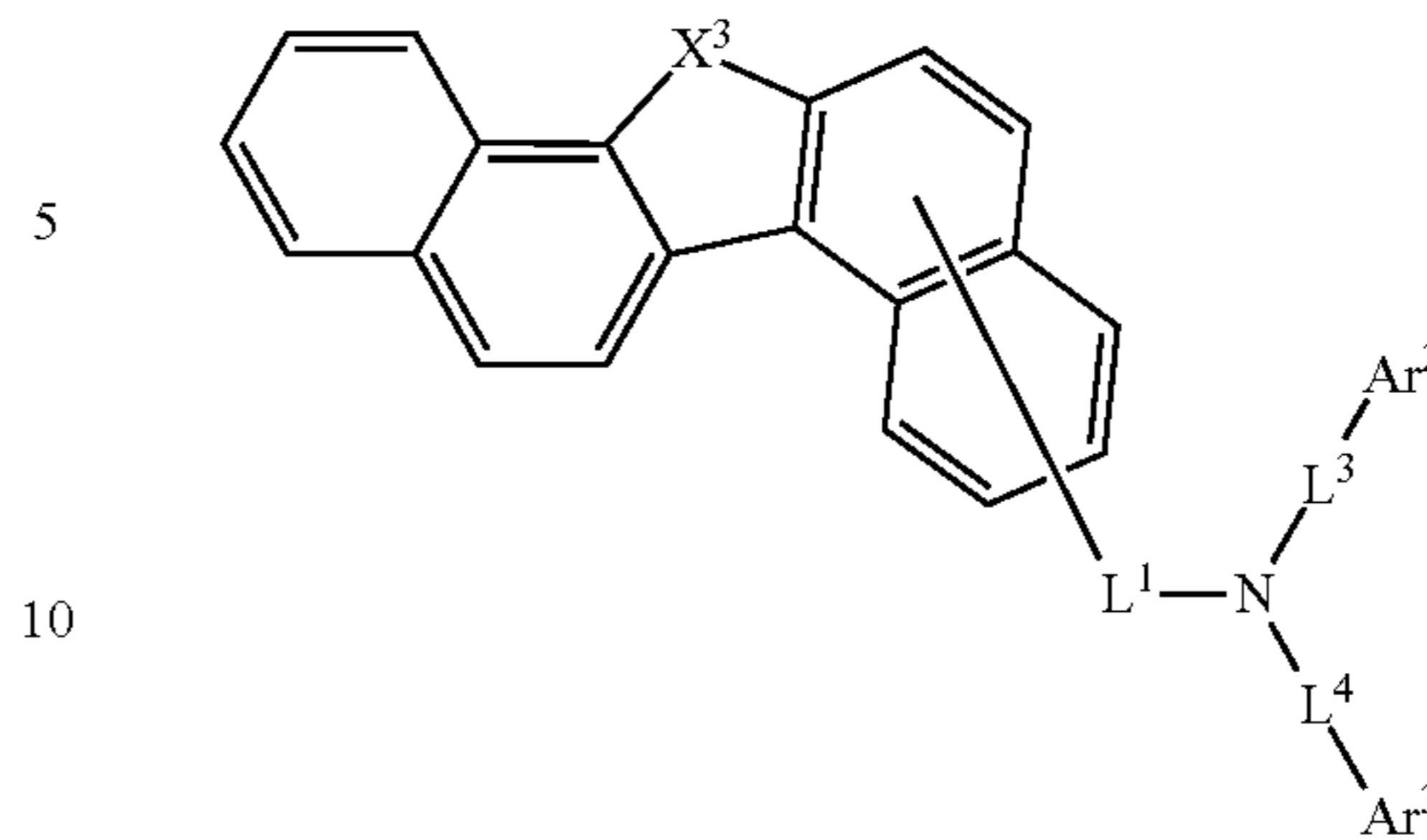
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Formula (18)



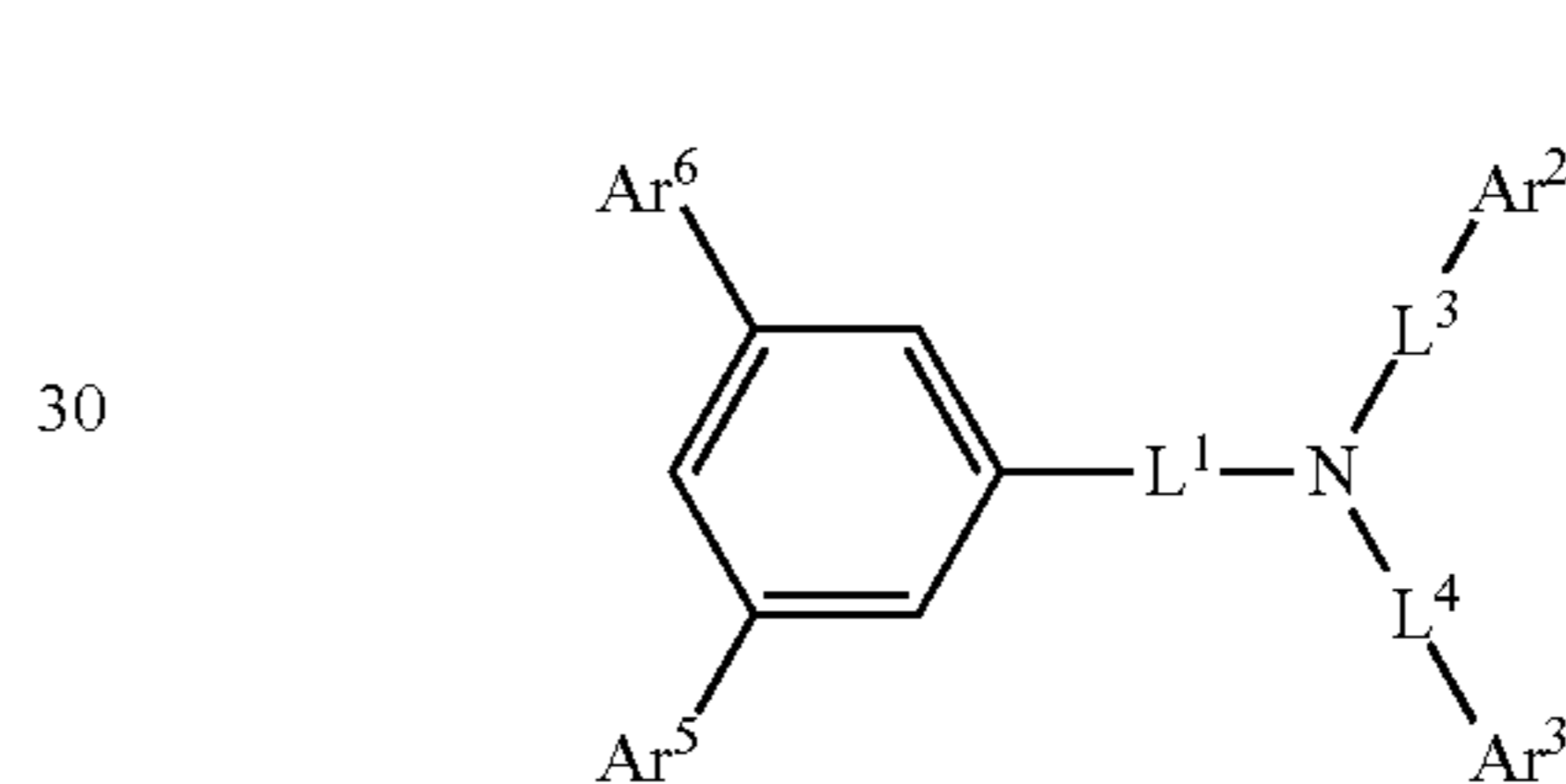
Formula (23)

15 wherein  $L^1$ ,  $L^3$ ,  $L^4$ ,  $Ar^2$ ,  $Ar^3$ ,  $X^3$ ,  $R^1$ ,  $R^2$ ,  $a$  and  $b$  are the same as defined in claim 2.

5. The organic electric element according to claim 1, wherein  $Ar^1$ ,  $Ar^2$  and  $Ar^3$  in Formula (1) are all  $C_6$ - $C_{24}$  aryl groups, and  $L^1$ ,  $L^3$  and  $L^4$  are single bonds or all  $C_6$ - $C_{24}$  aryl groups.

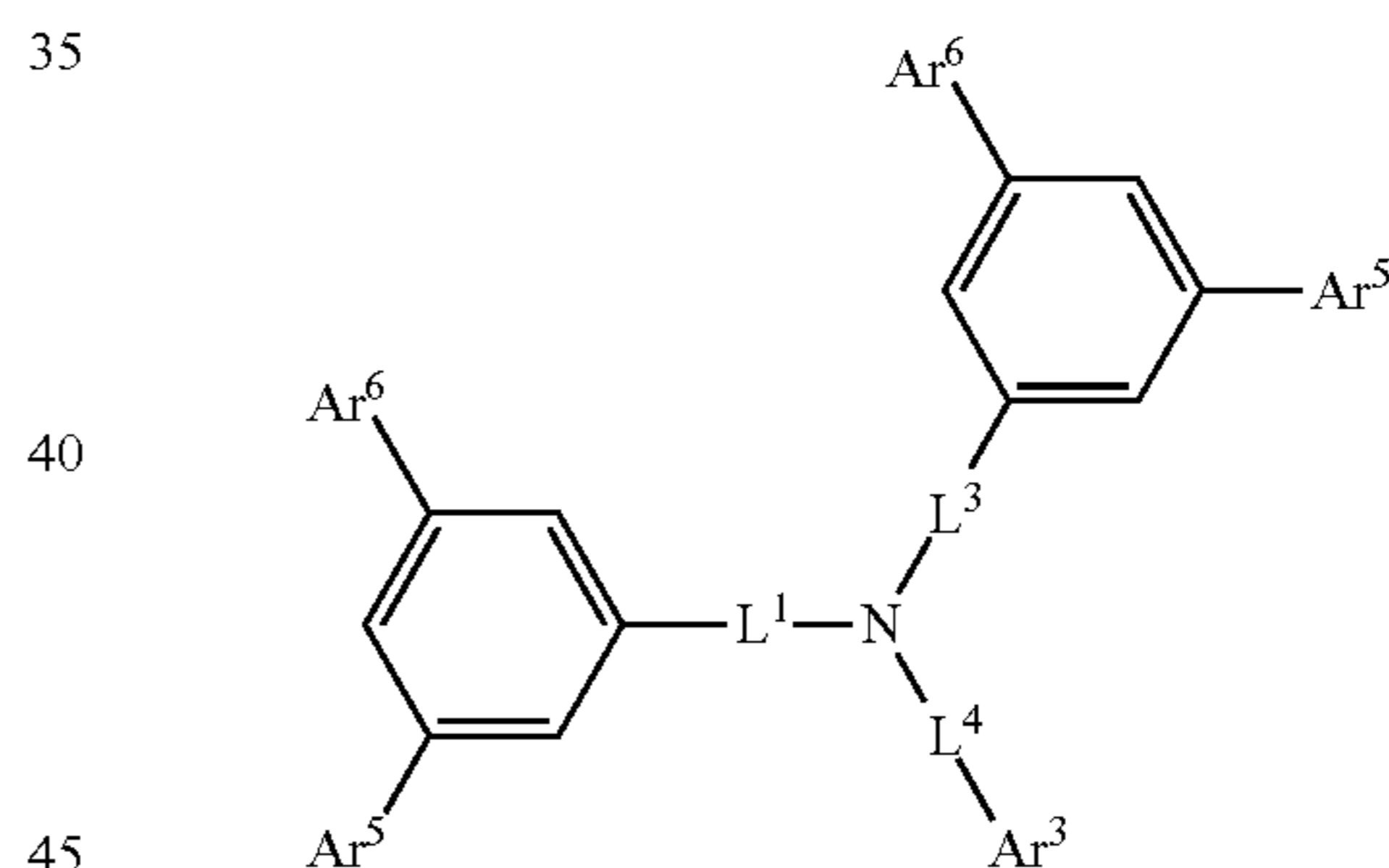
6. The organic electric element according to claim 1, wherein the first host compound represented by Formula (1) is represented by any one of the following Formulas (24) to (26):

Formula (20)



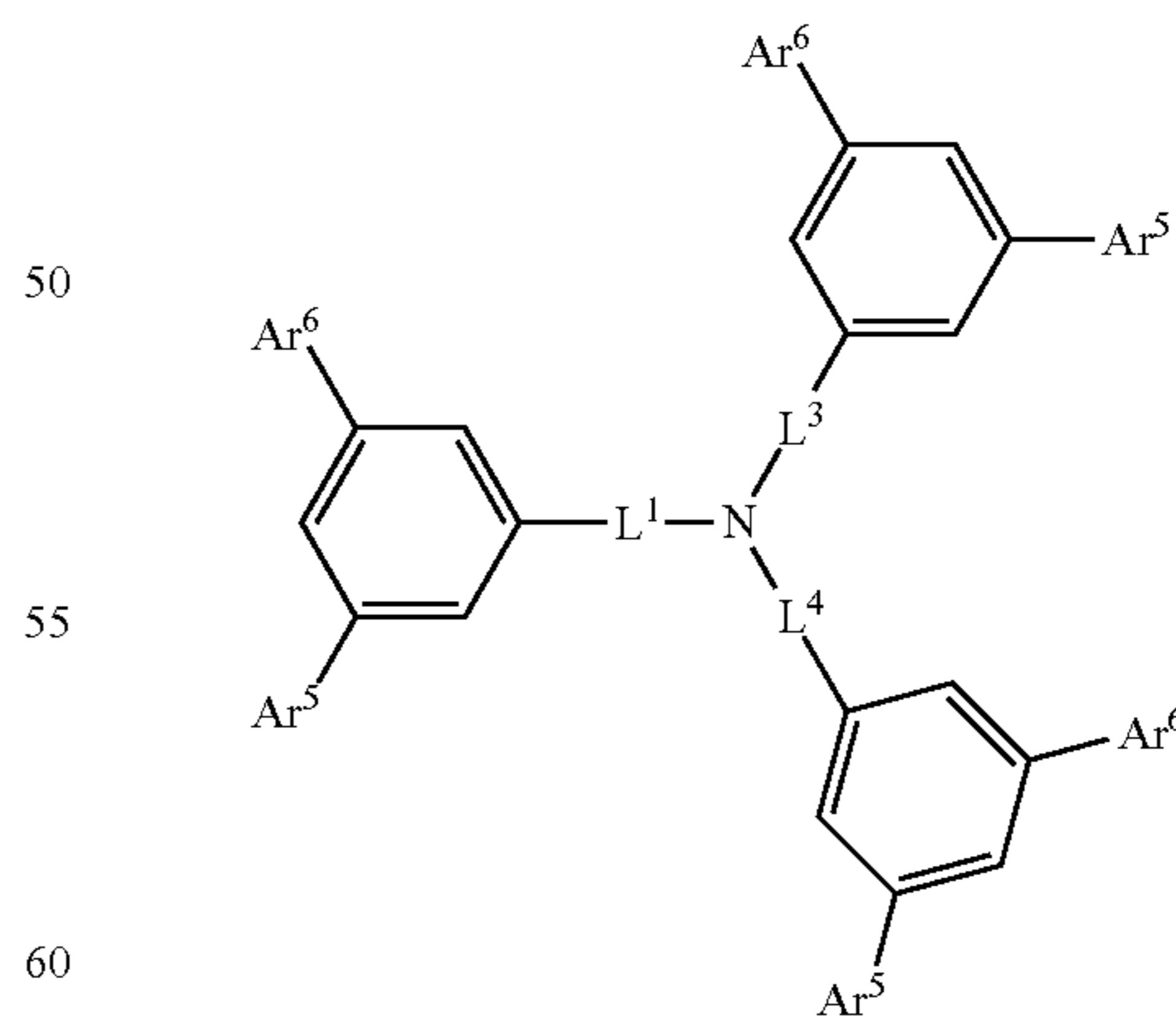
Formula (24)

Formula (21)



Formula (25)

Formula (22)



Formula (26)

wherein:

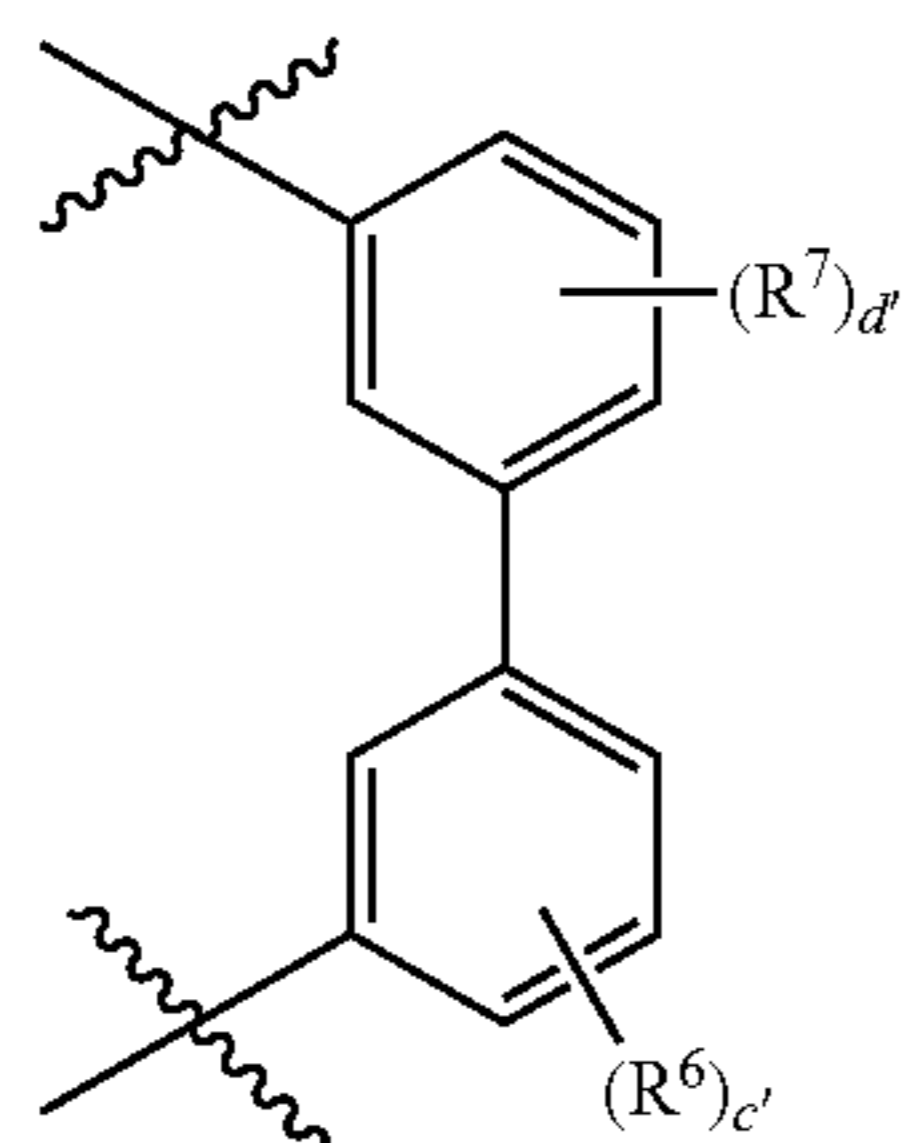
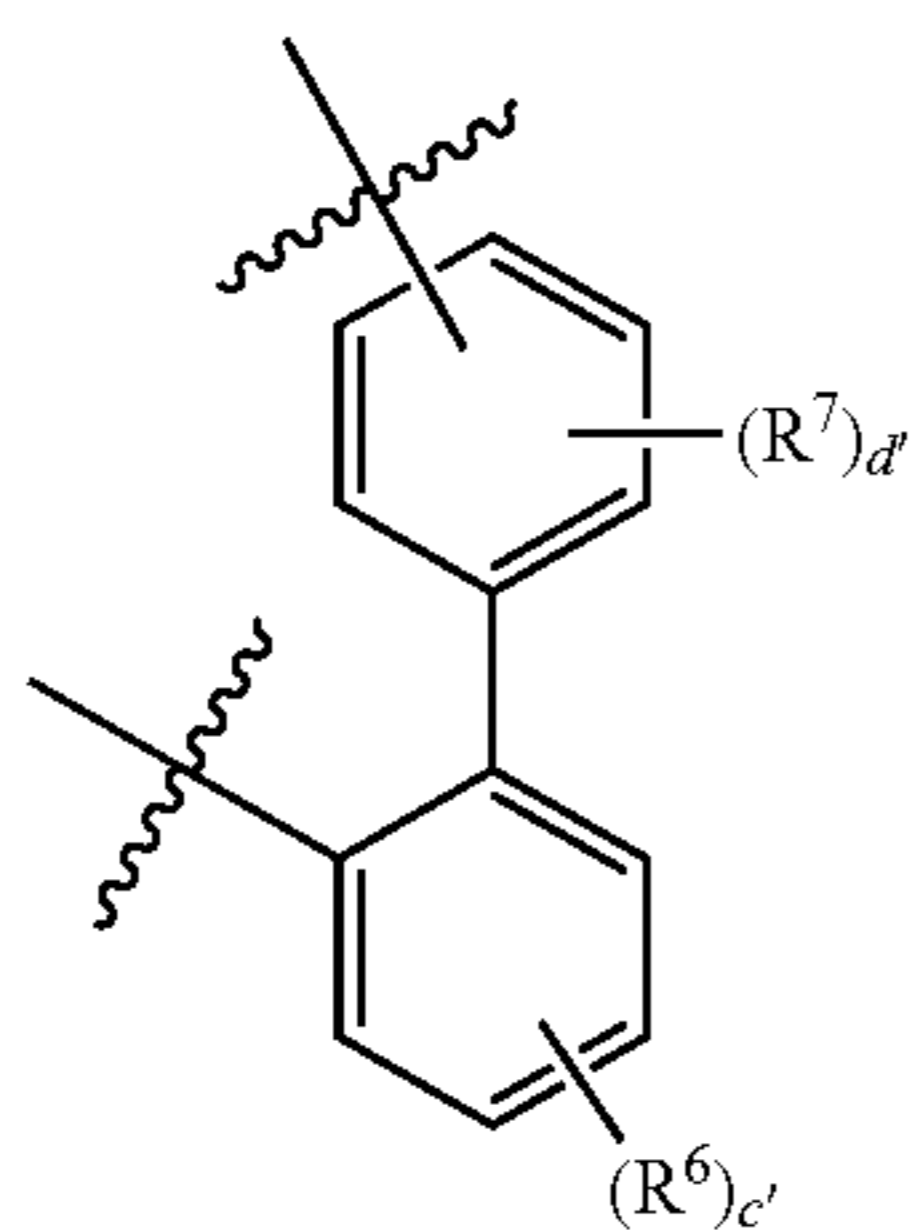
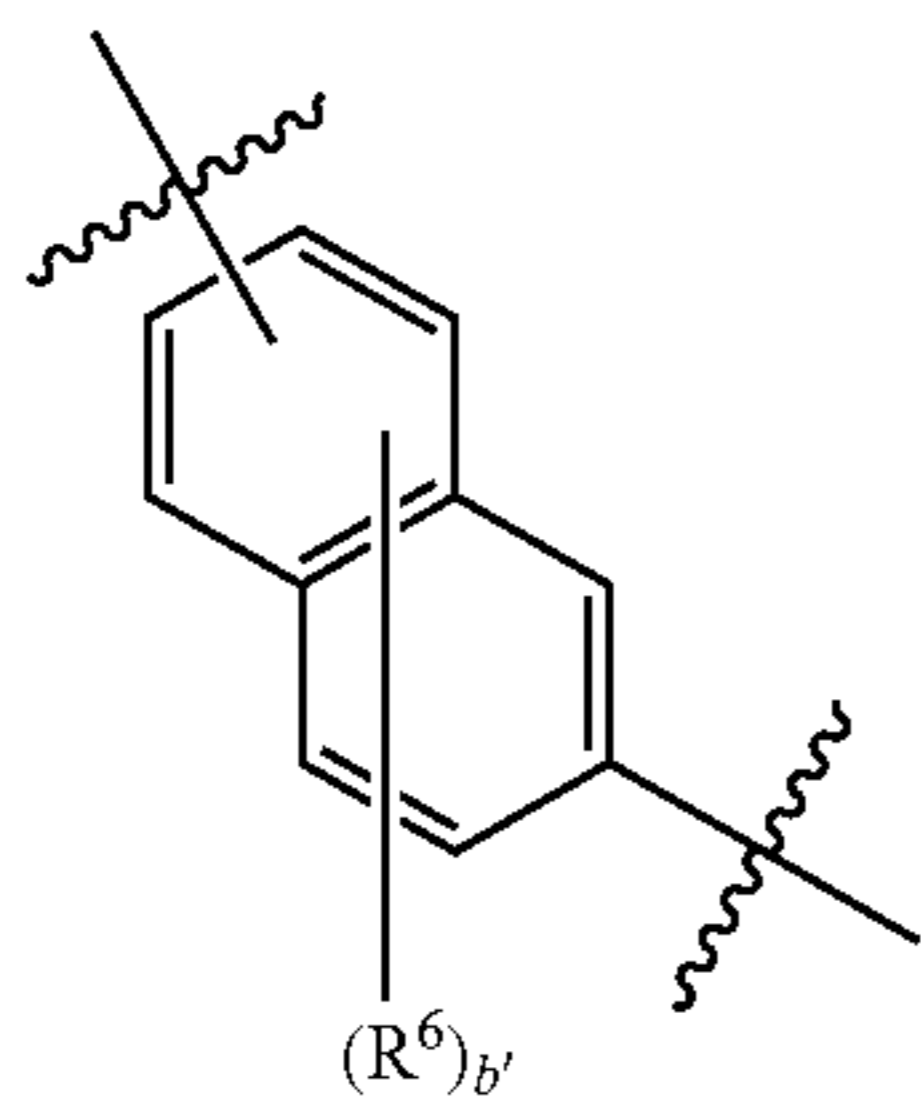
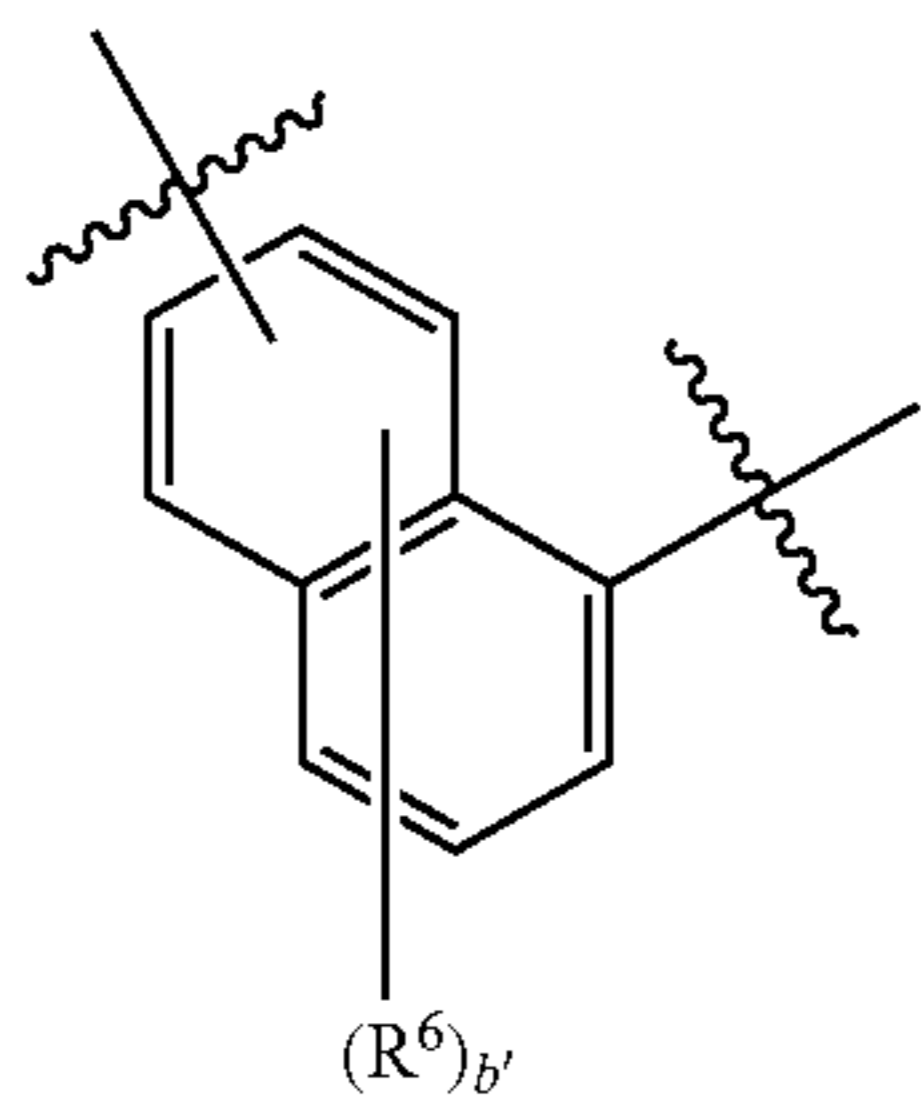
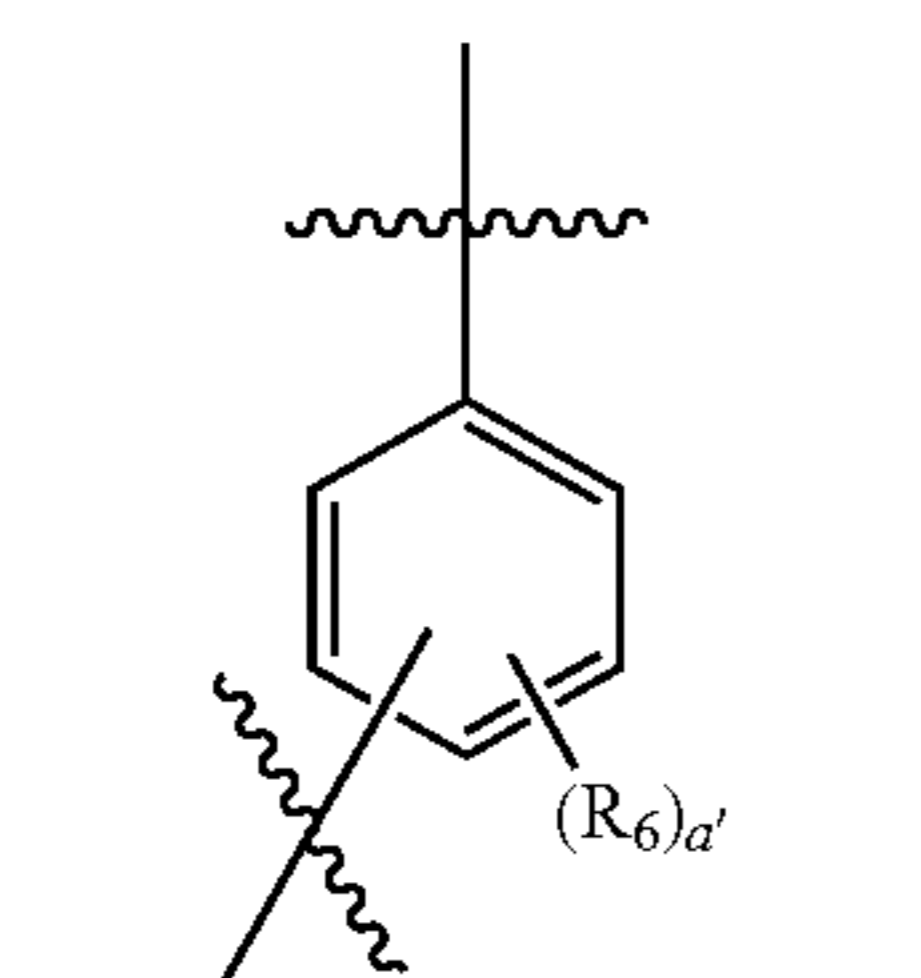
1)  $L^1$ ,  $L^3$ ,  $L^4$ ,  $Ar^2$  and  $Ar^3$  are the same as defined in claim 1,

2)  $Ar^5$  and  $Ar^6$  are each independently selected from the group consisting of a  $C_6$ - $C_{60}$  aryl group; a  $C_2$ - $C_{60}$

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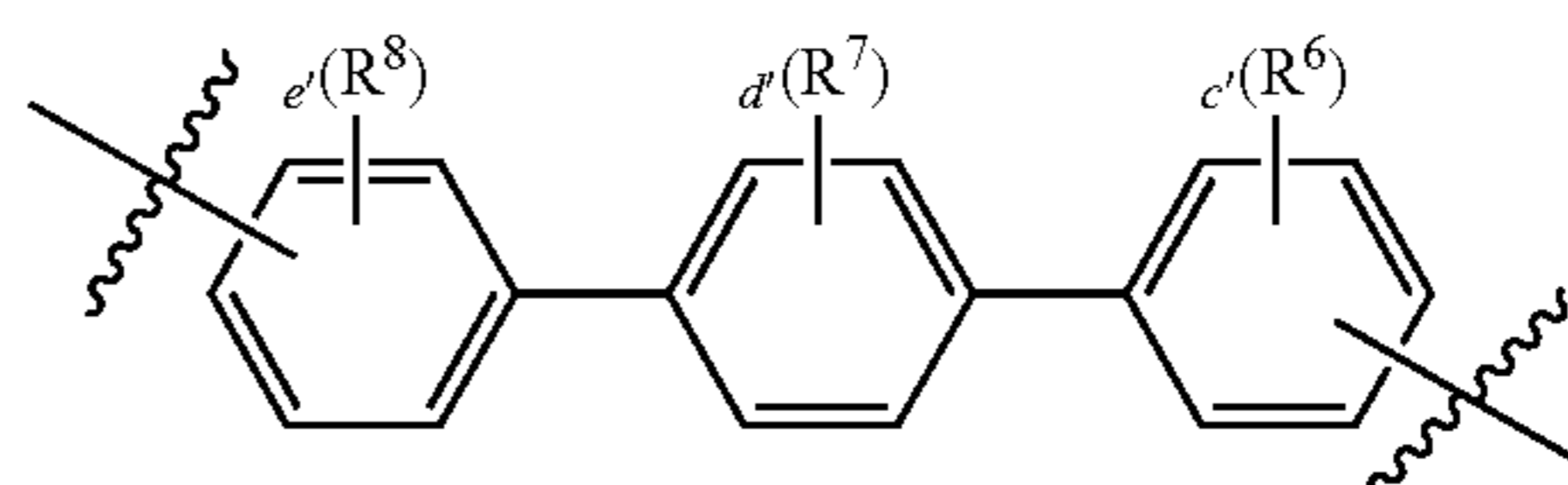
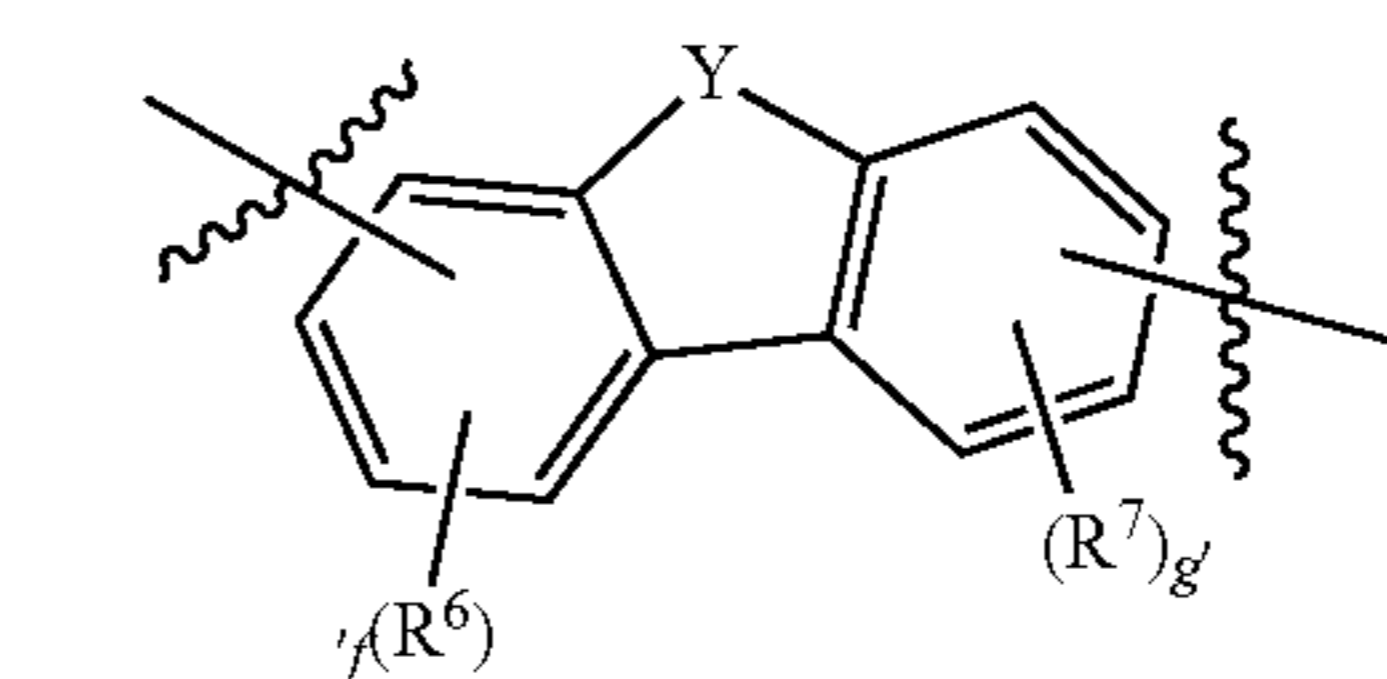
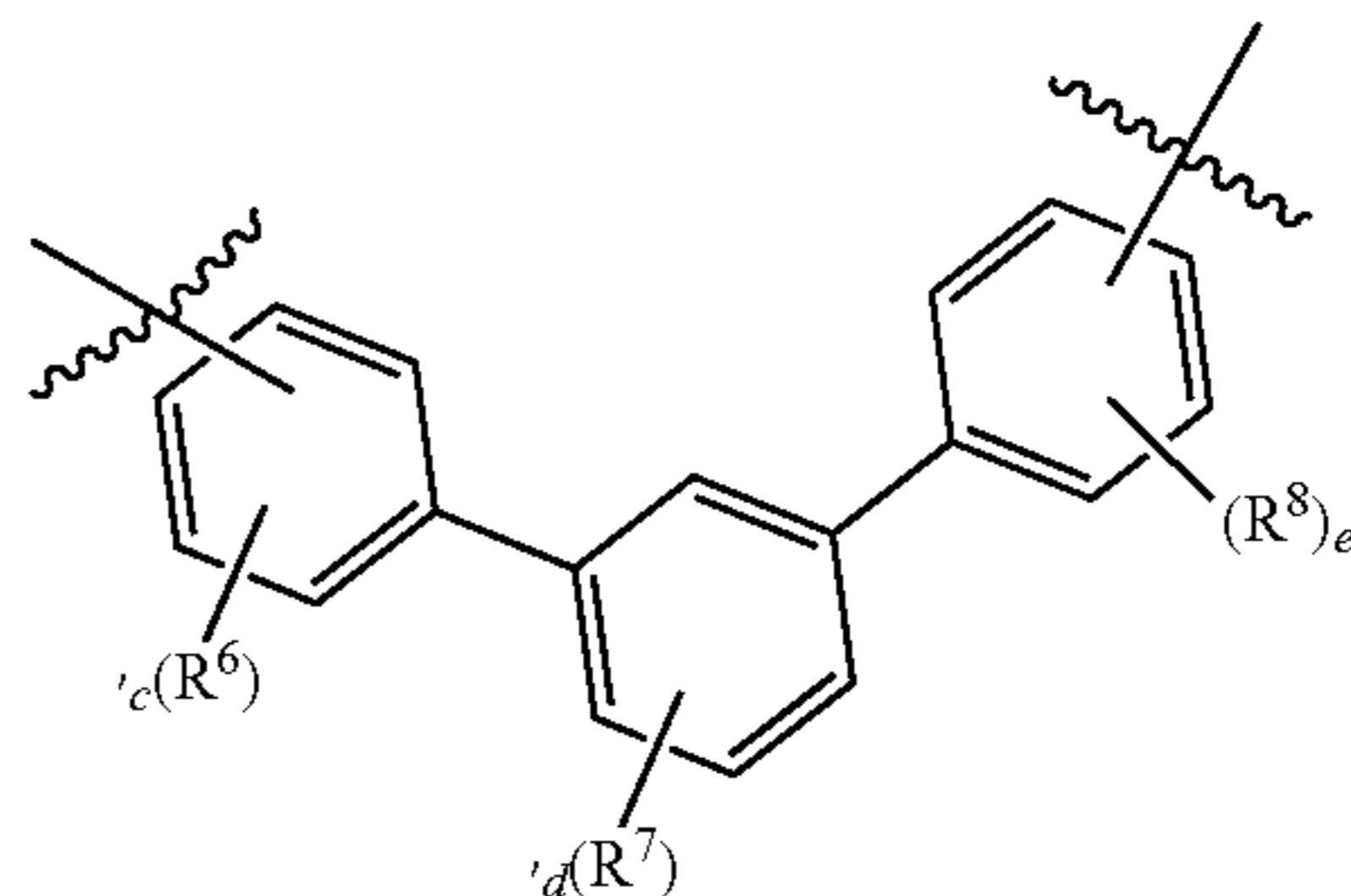
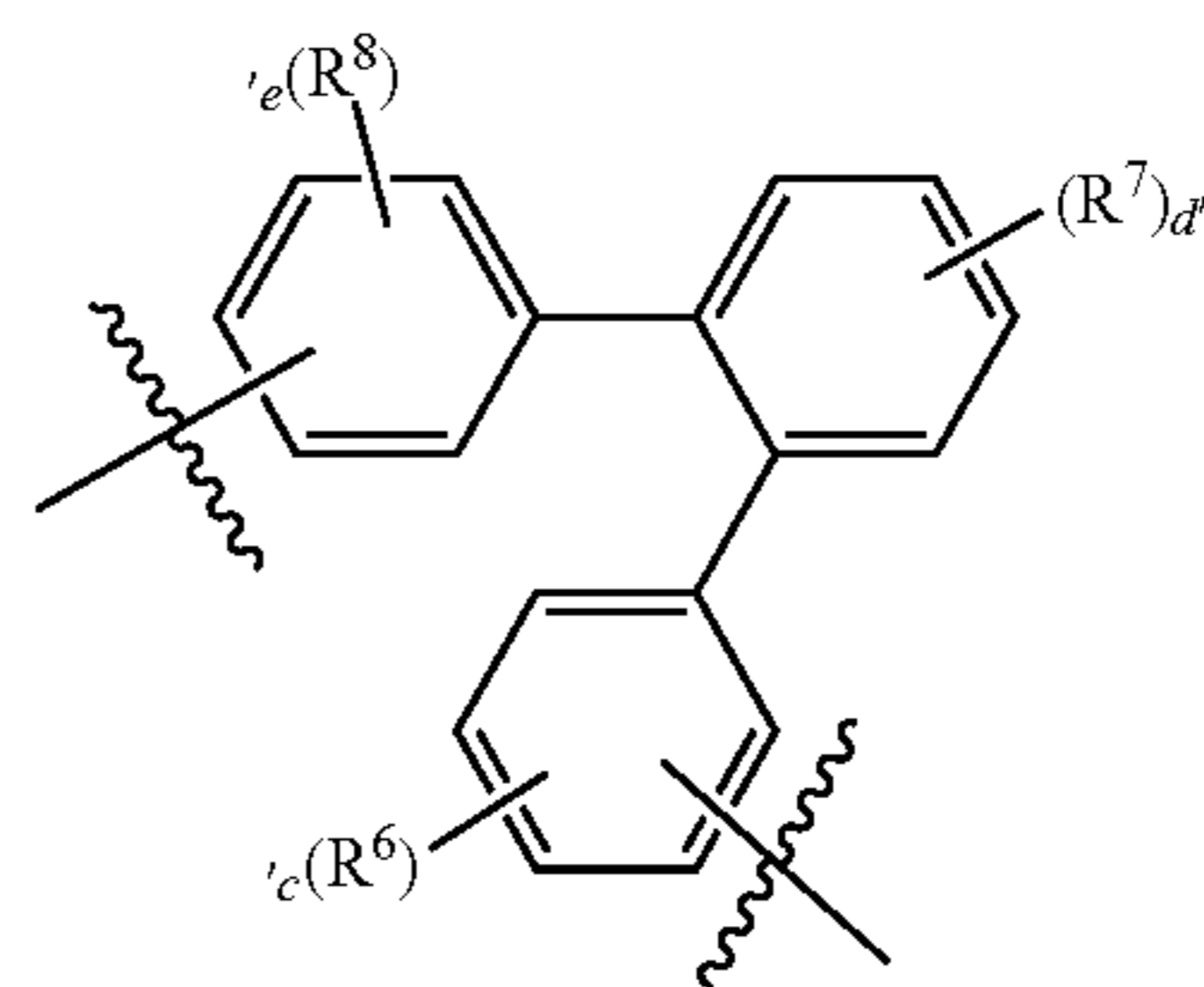
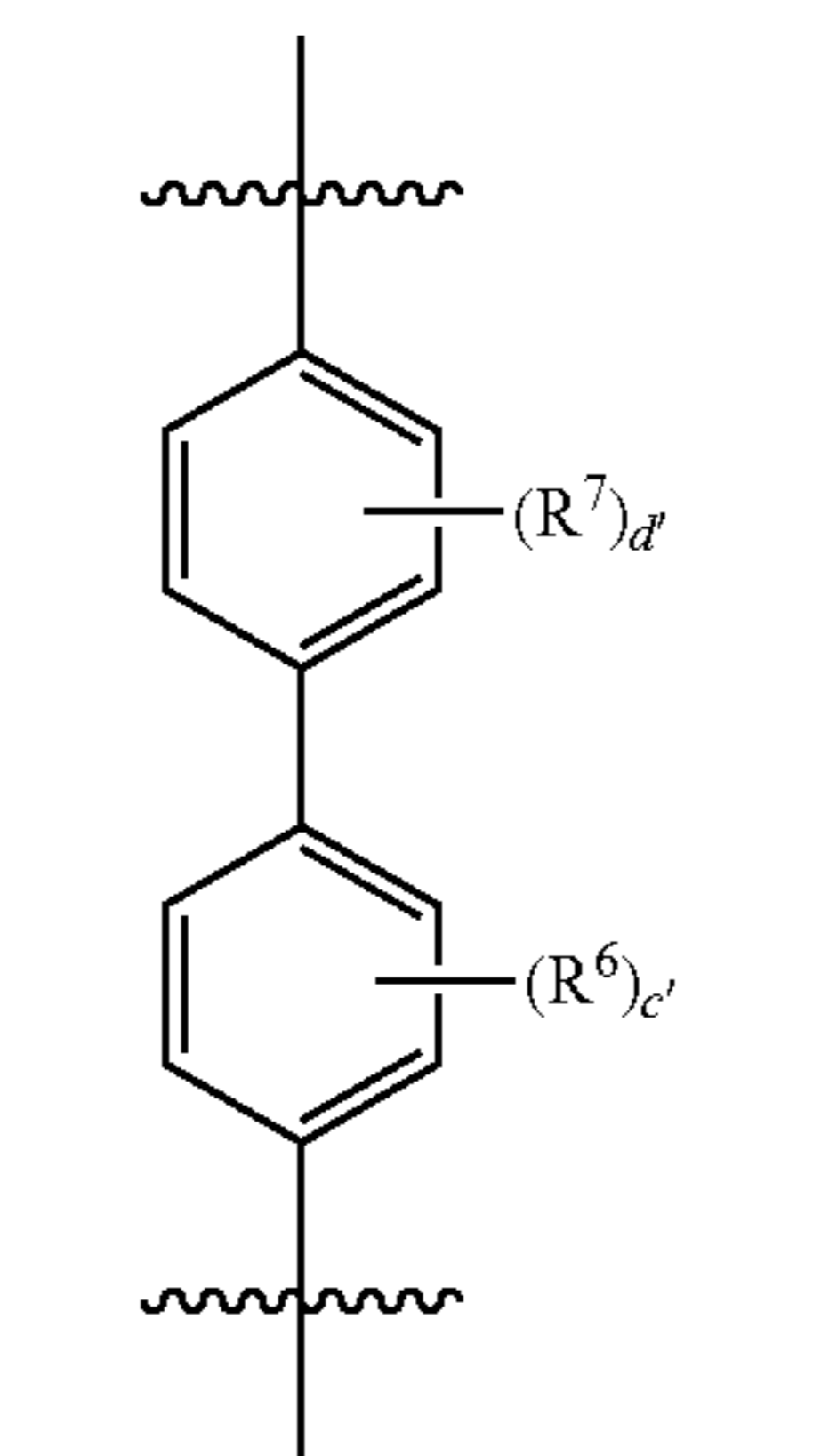
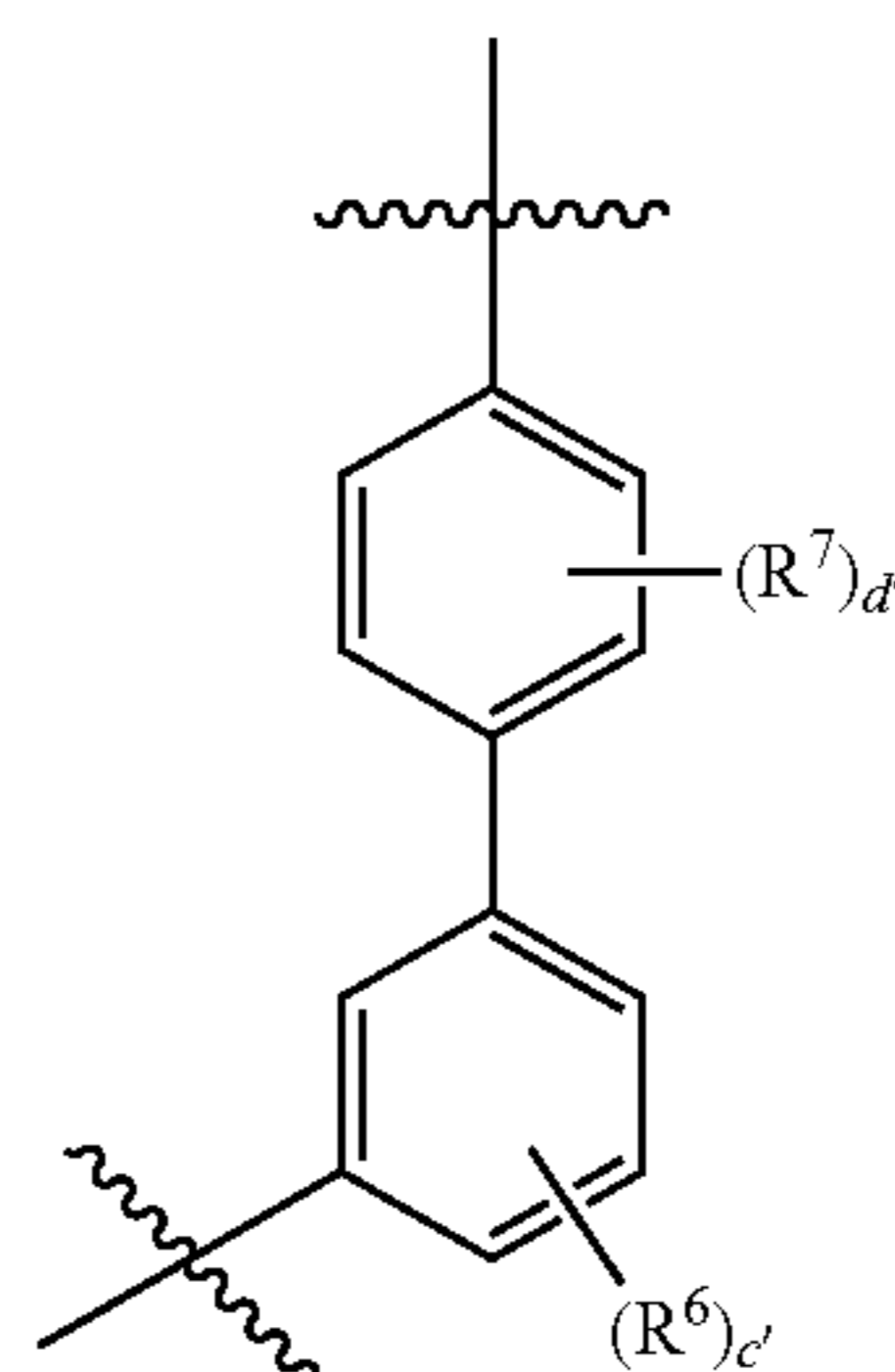
heterocyclic group including at least one heteroatom of O, N, S, Si and P; a fused ring group of a C<sub>3</sub>-C<sub>60</sub> aliphatic ring and a C<sub>6</sub>-C<sub>60</sub> aromatic ring; a C<sub>1</sub>-C<sub>50</sub> alkyl group; a C<sub>2</sub>-C<sub>20</sub> alkenyl group; a C<sub>2</sub>-C<sub>20</sub> alkynyl group; a C<sub>1</sub>-C<sub>30</sub> alkoxy group; a C<sub>6</sub>-C<sub>30</sub> aryloxy group; and —L<sup>1</sup>-N(R<sub>a</sub>)(R<sub>b</sub>).

7. The organic electric element according to claim 1, wherein L<sup>1</sup>, L<sup>3</sup> and L<sup>4</sup> in Formula (1) are selected from the group consisting of the following Formulas (A-1) to (A-12):



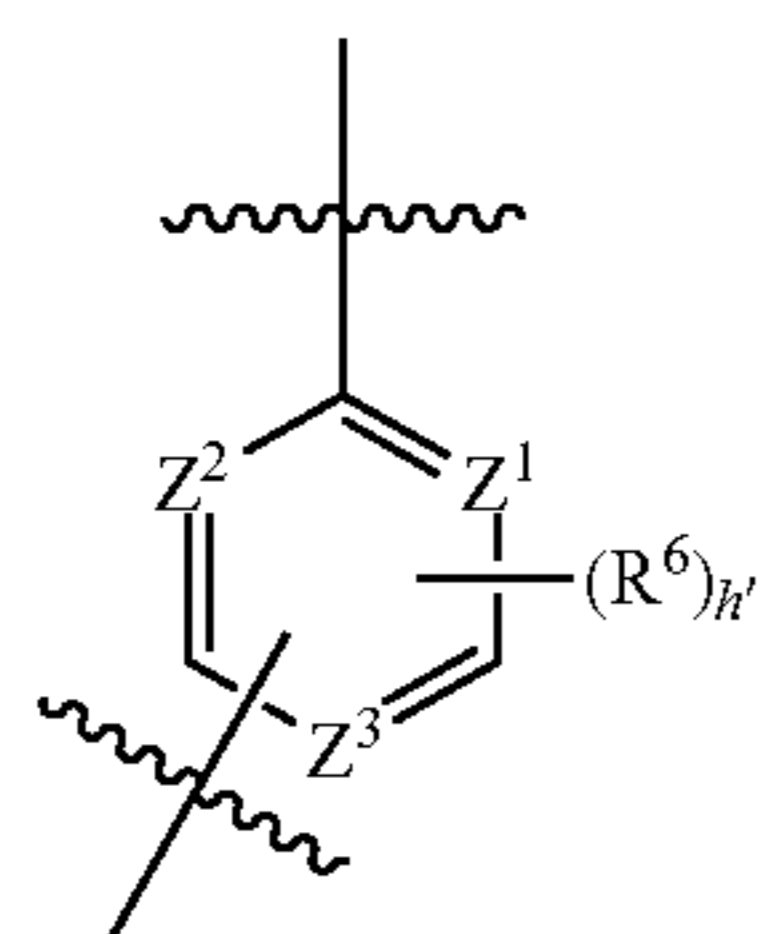
180

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(A-12)

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wherein:

1)  $a'$ ,  $c'$ ,  $d'$  and  $e'$  are each an integer of 0 to 4,  $b'$  is an integer of 0 to 6,  $f'$  and  $g'$  are each an integer of 0 to 3, and  $h'$  is an integer of 0 to 1,

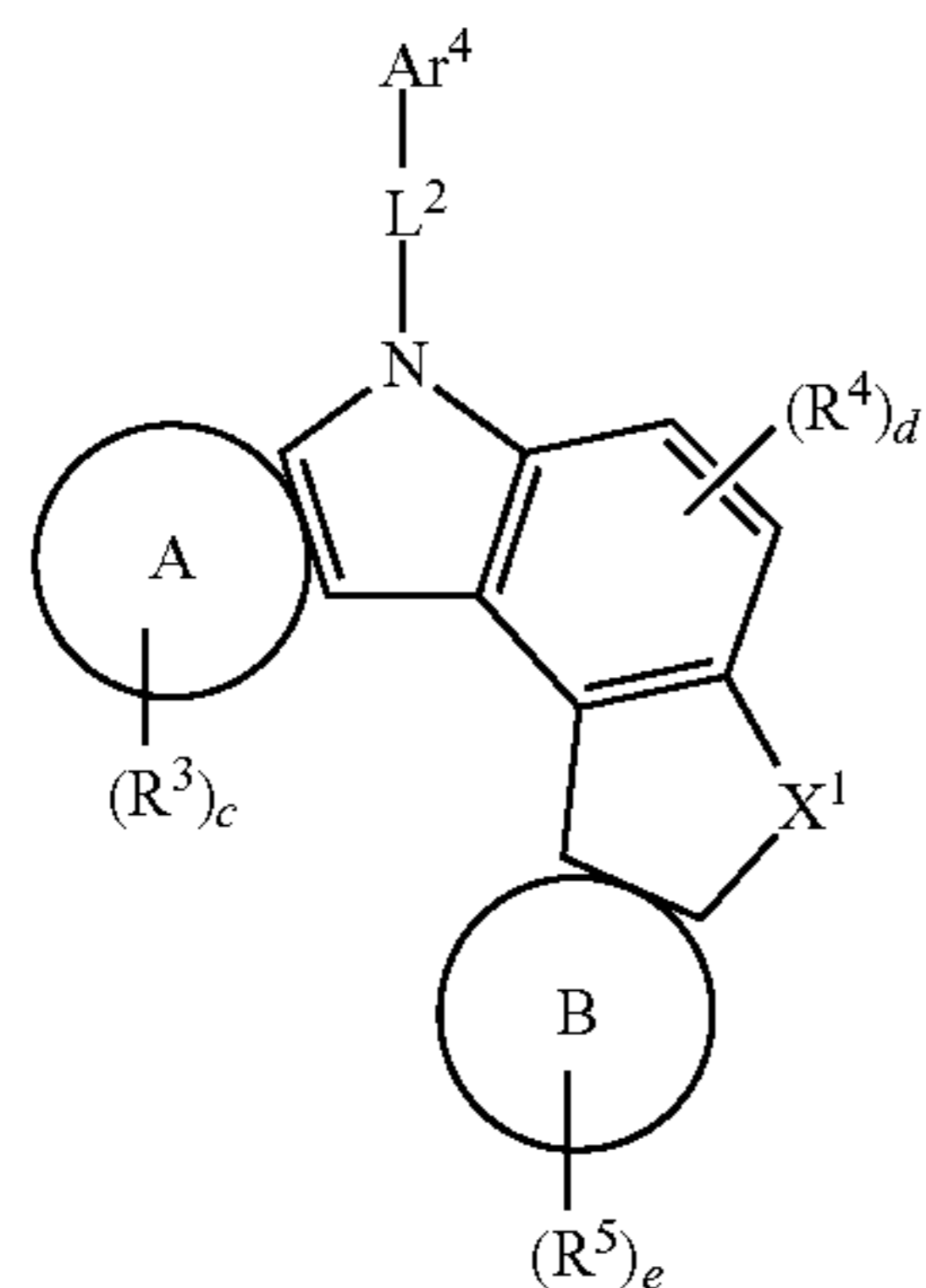
2)  $R^6$ ,  $R^7$  and  $R^8$  are the same or different from each other, and are each independently selected from the group consisting of deuterium; halogen; a  $C_6$ - $C_{60}$  aryl group; a fluorenyl group; a  $C_2$ - $C_{60}$  heterocyclic group including at least one heteroatom of O, N, S, Si and P; a fused ring group of a  $C_3$ - $C_{60}$  aliphatic ring and a  $C_6$ - $C_{60}$  aromatic ring; a  $C_1$ - $C_{50}$  alkyl group; a  $C_2$ - $C_{20}$  alkenyl group; a  $C_2$ - $C_{20}$  alkynyl group; a  $C_1$ - $C_{30}$  alkoxy group; a  $C_6$ - $C_{30}$  aryloxy group; and  $-L^1-N(R_a)(R_b)$ ; or wherein  $f'$  and  $g'$  are 2 or more,  $R^6$ ,  $R^7$  and  $R^8$  are each in plural being the same as or different from each other, and a plurality of  $R^6$  or a plurality of  $R^7$  or adjacent  $R^6$  and  $R^7$  may combine to each other to form an aromatic or a heteroaromatic ring,

3) Y is  $NR^1$ , O, S or  $CR^1R^2$ , and  $R^1$  and  $R^2$  are the same as defined in claim 1,

4)  $Z^1$ ,  $Z^2$  and  $Z^3$  are each independently  $CR^1$  or N, and at least one is N.

8. The organic electric element according to claim 1, wherein at least one of  $L^1$ ,  $L^3$ , and  $L^4$  in Formula (1) is a phenyl group and is substituted on a m(meta)-position.

9. The organic electric element according to claim 1, wherein the second host compound represented by Formula (2) comprises a compound represented by the following Formula (27) or (28):



Formula (27)

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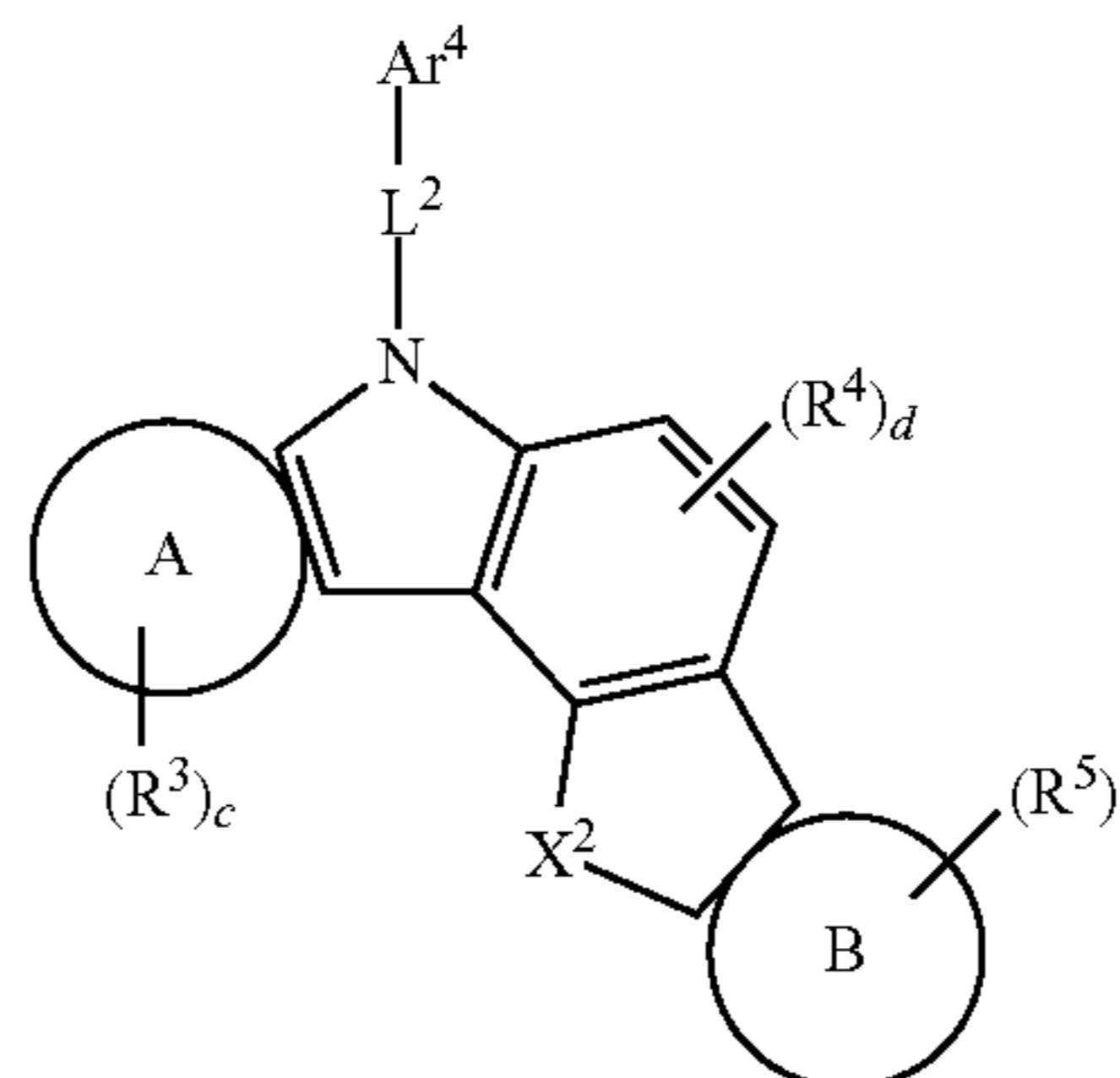
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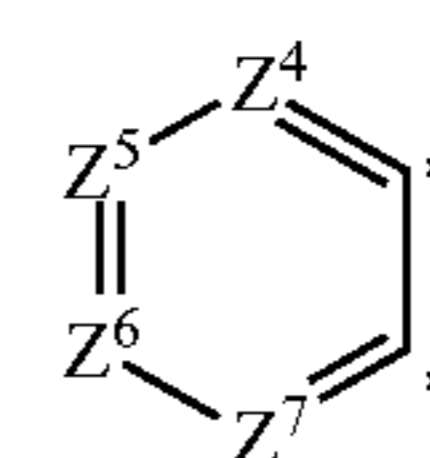
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Formula (28)

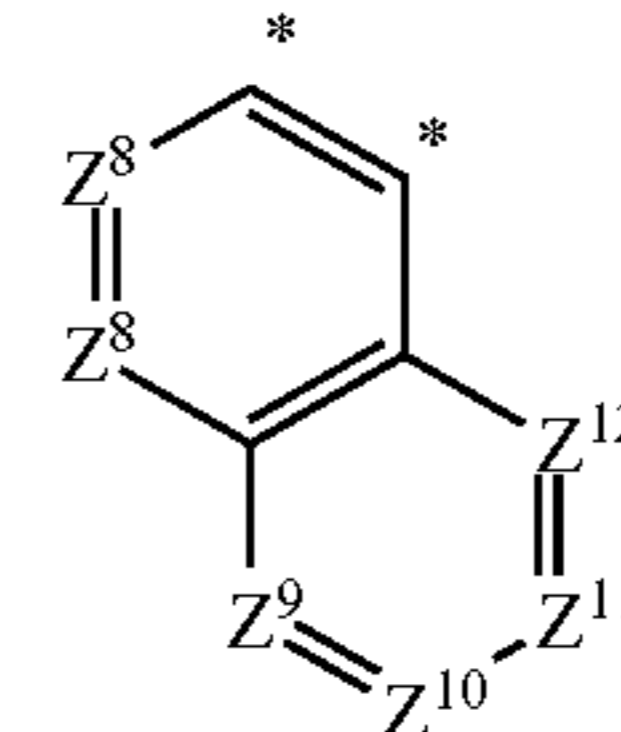


wherein  $R^3$ ,  $R^4$ ,  $R^5$ ,  $Ar^4$ ,  $L^2$ ,  $c$ ,  $d$ ,  $e$ ,  $A$ ,  $B$ ,  $X^1$  and  $X^2$  are the same as defined in claim 1.

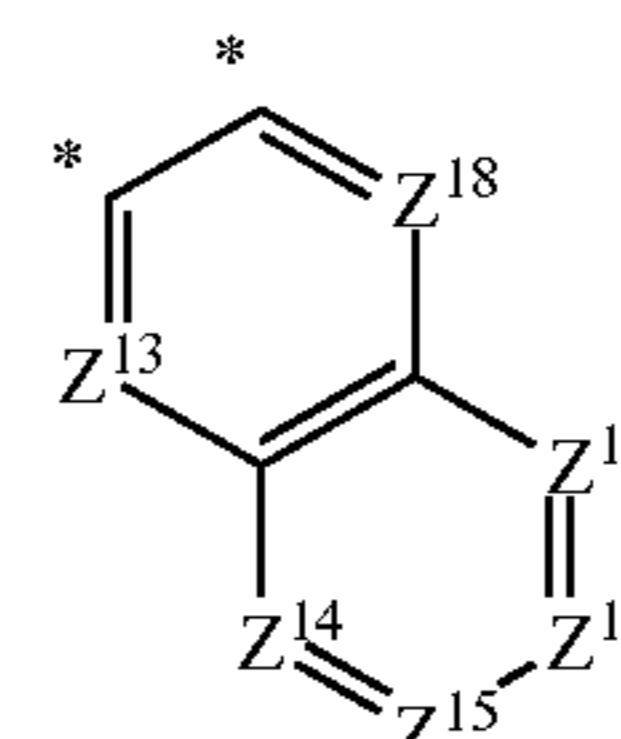
10. The organic electric element according to claim 1, wherein A and B in Formula (2) are selected from the group consisting of the following Formulas (B-1) to (B-7):



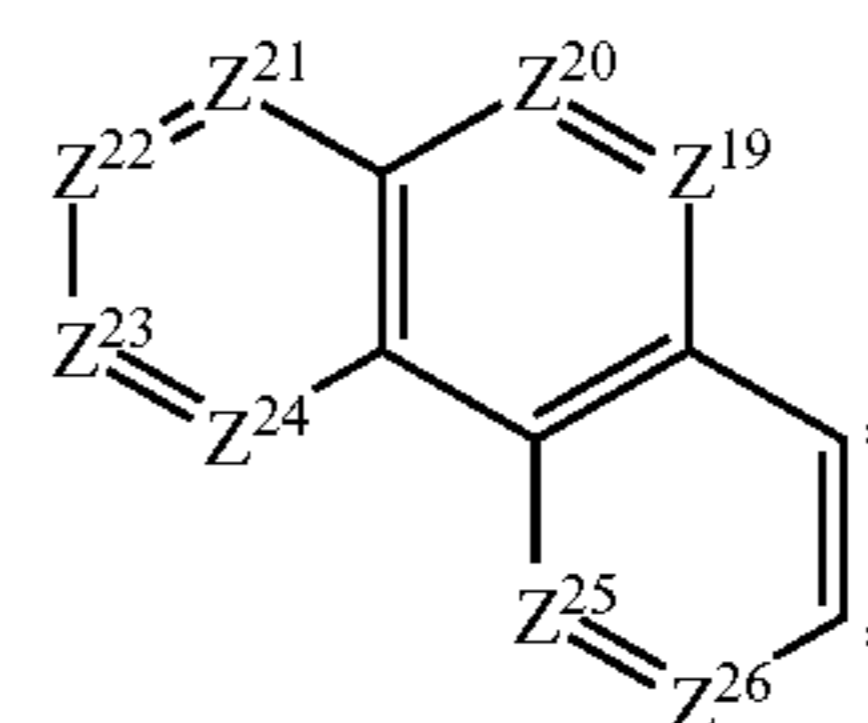
(B-1)



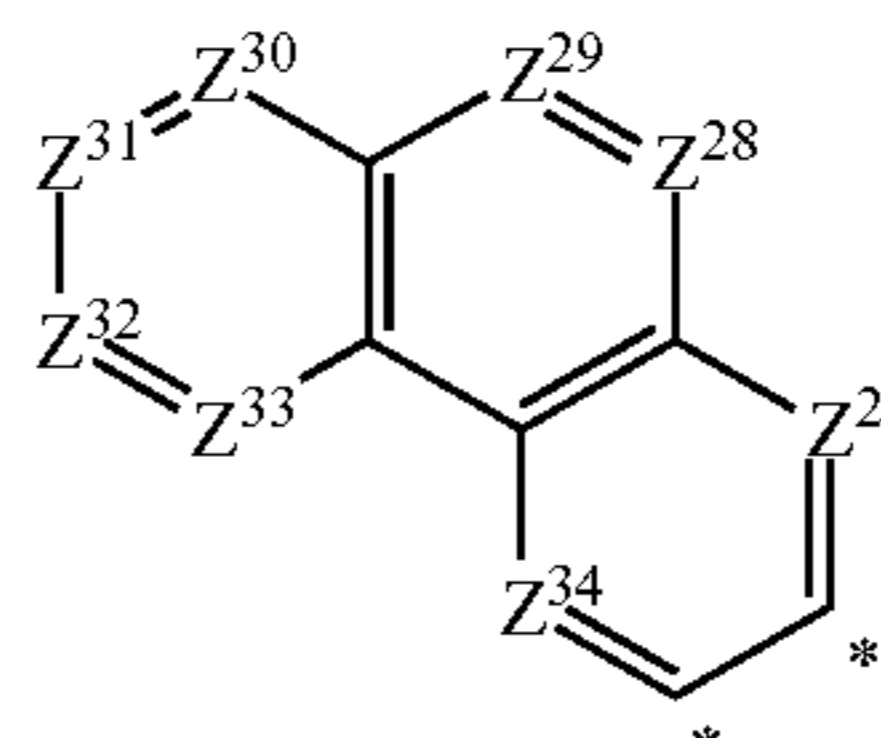
(B-2)



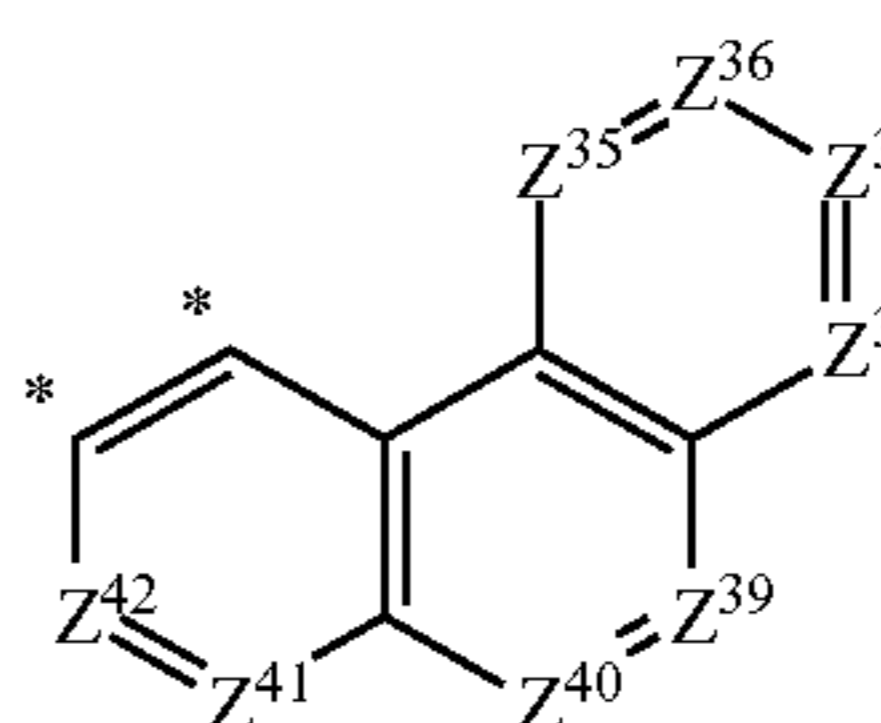
(B-3)



(B-4)



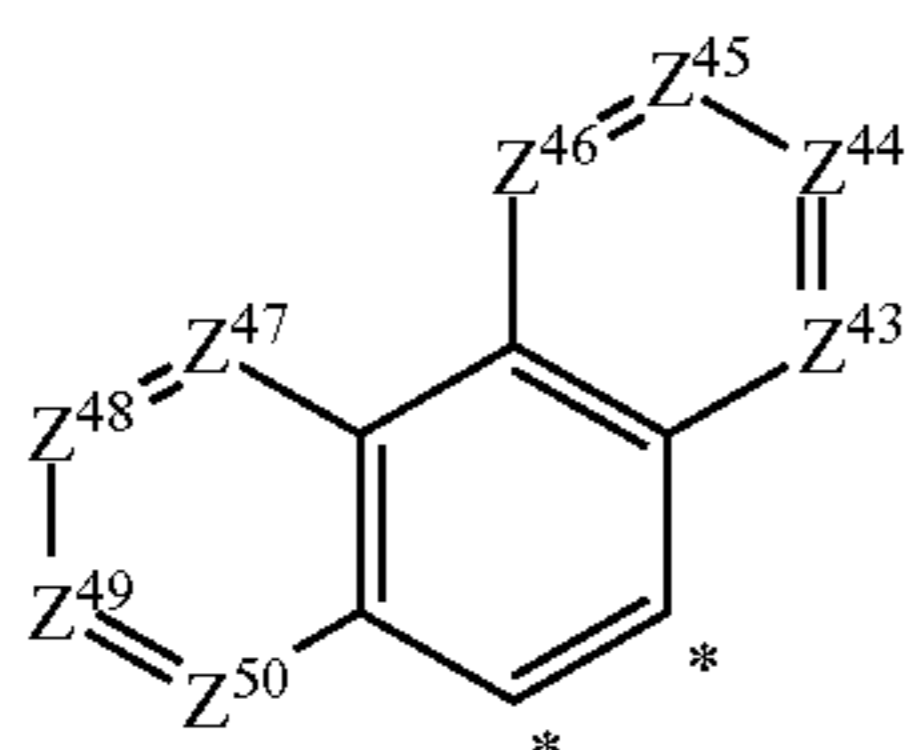
(B-5)



(B-6)

183

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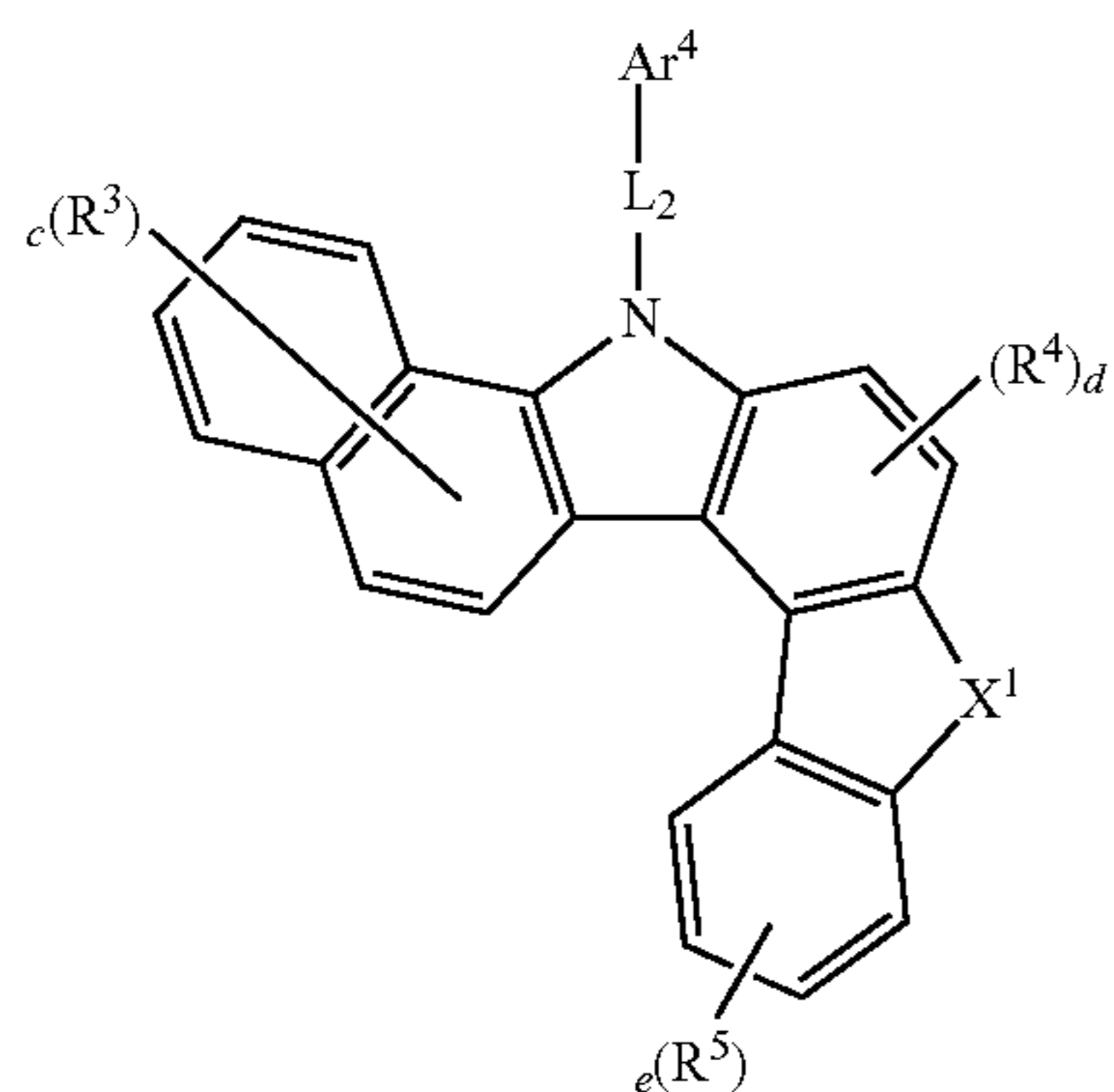


wherein:

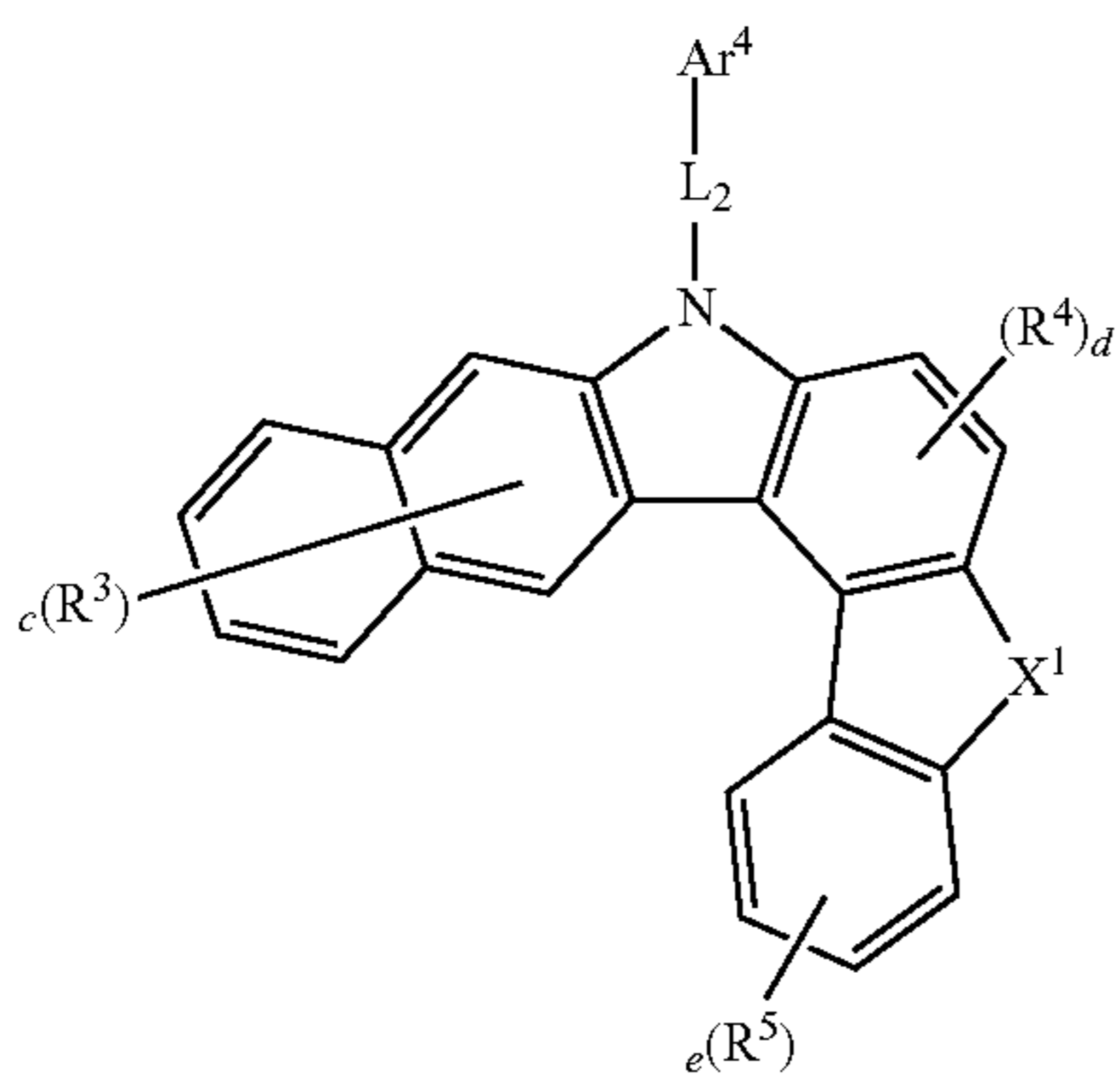
- 1)  $Z^4$  to  $Z^{50}$  are  $CR'$  or  $N$ ,
- 2)  $R'$  is the same as defined in Formula (2),
- 3) \* indicates the position to be condensed.

11. The organic electric element according to claim 1, wherein  $d$  in Formula (2) is 2, and  $R^4$ 's are bonded to form a ring to form an aromatic group or a heterocyclic ring.

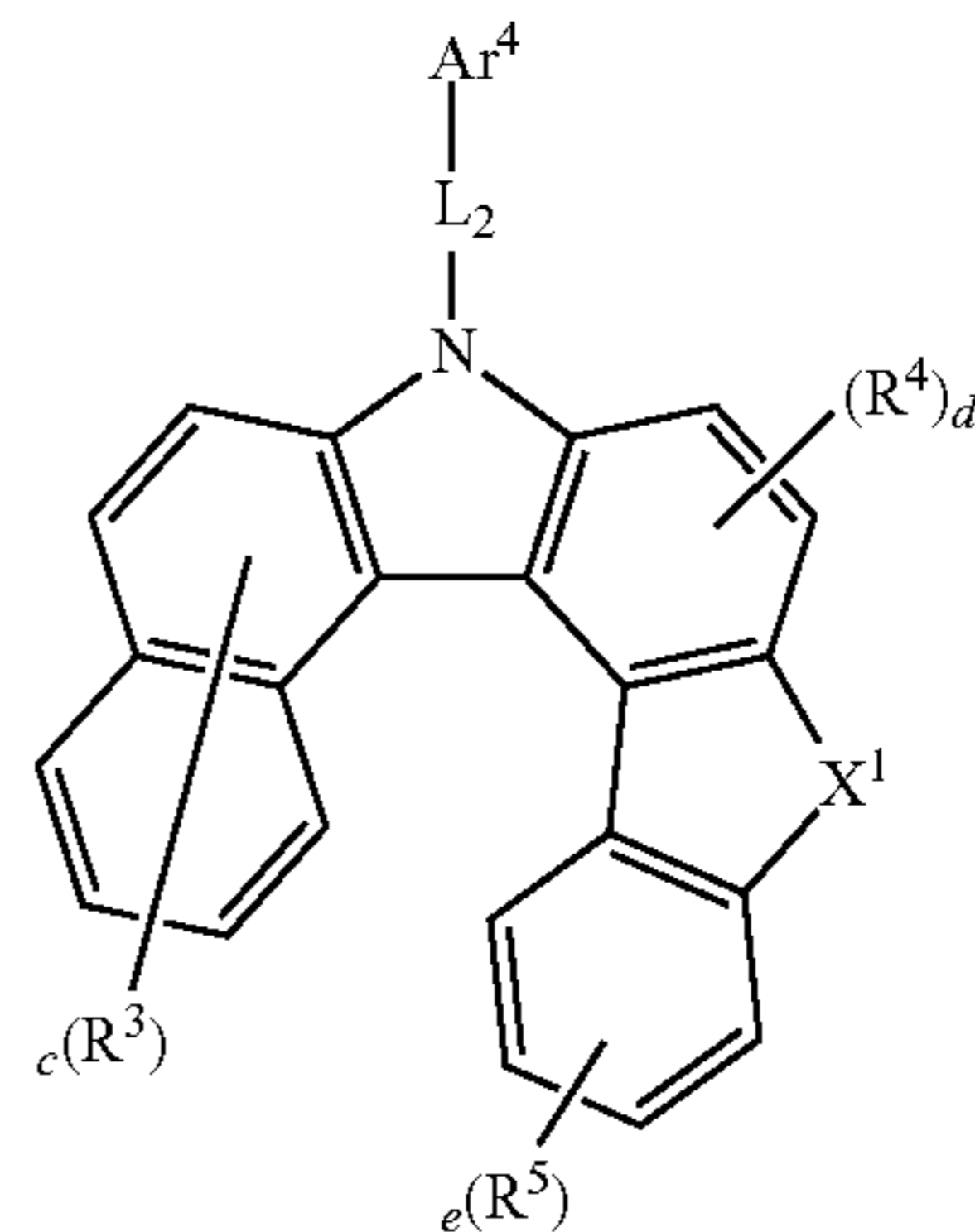
12. The organic electric element according to claim 1, wherein the second host compound represented by Formula (2) includes a compound represented by any of the following Formulas (29) to (48):



Formula (29)



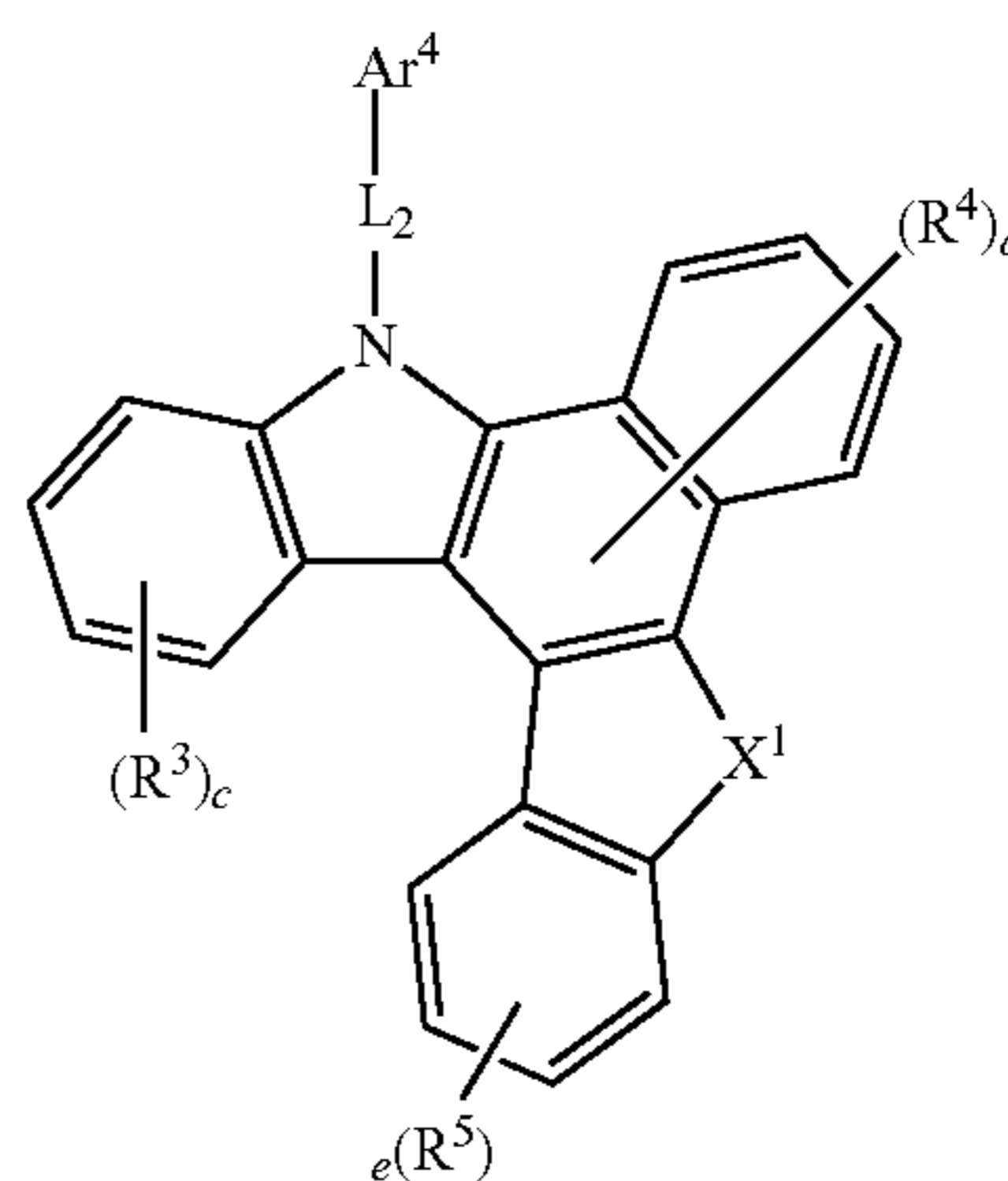
Formula (30)



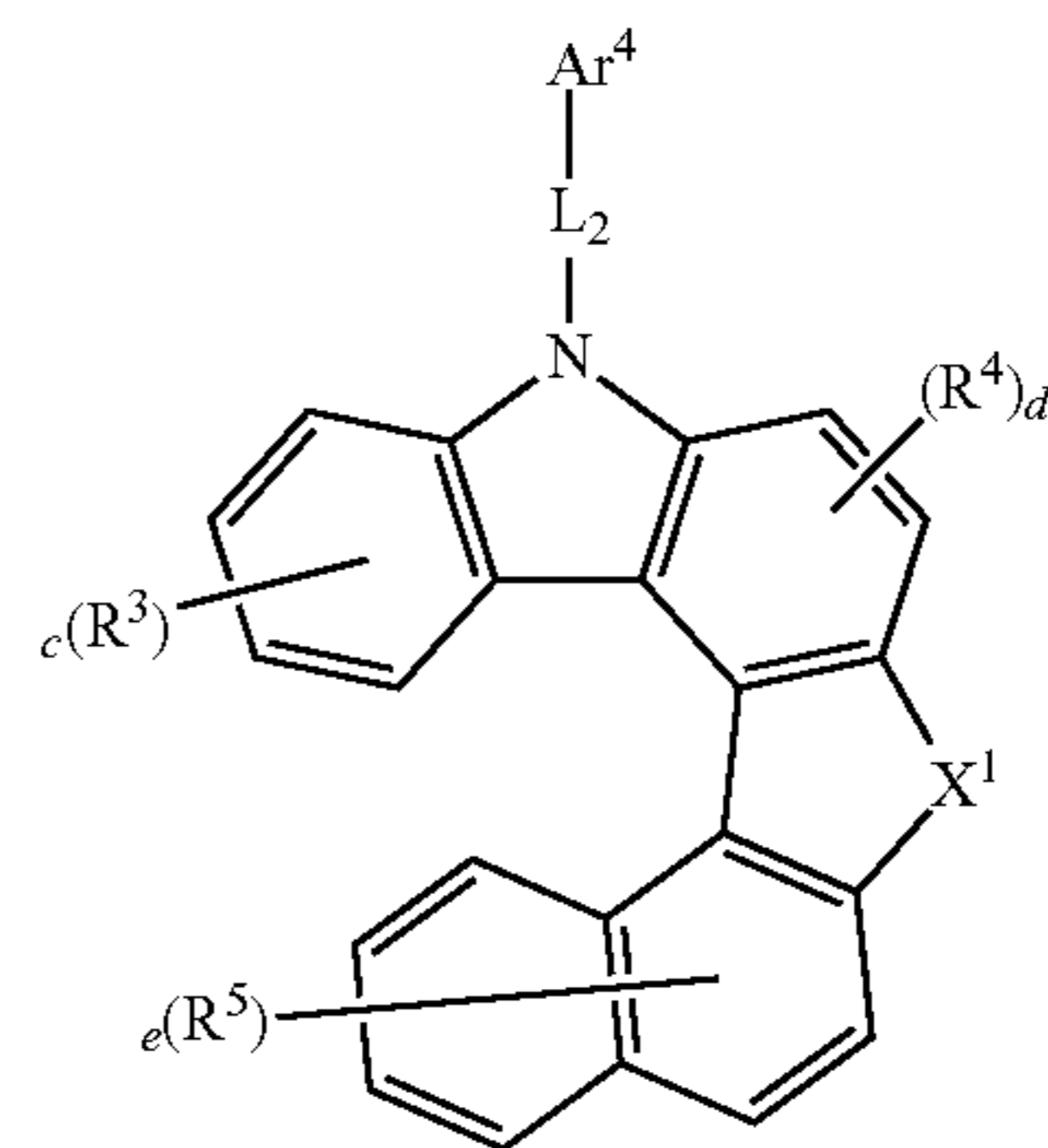
184

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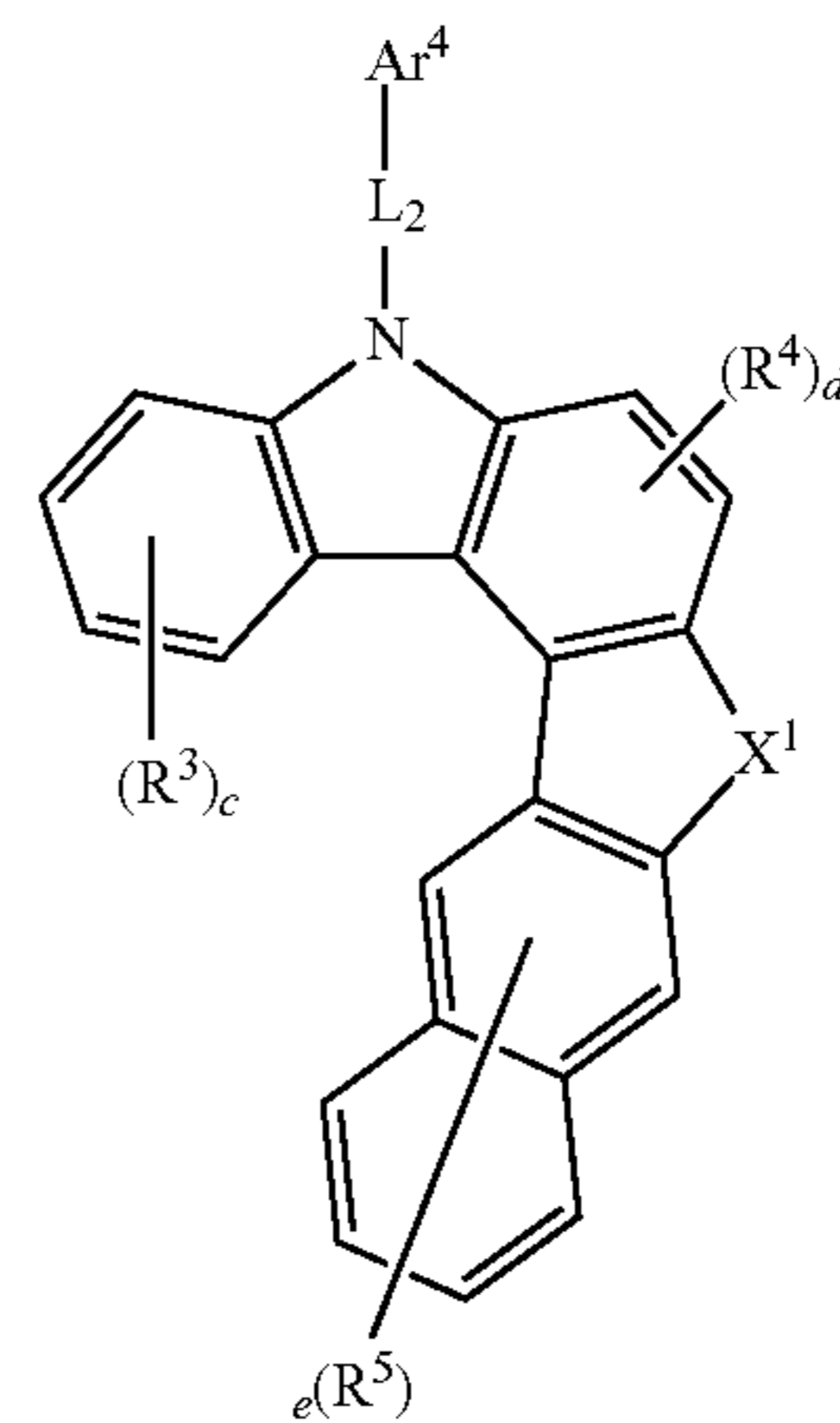
Formula (31)



Formula (32)



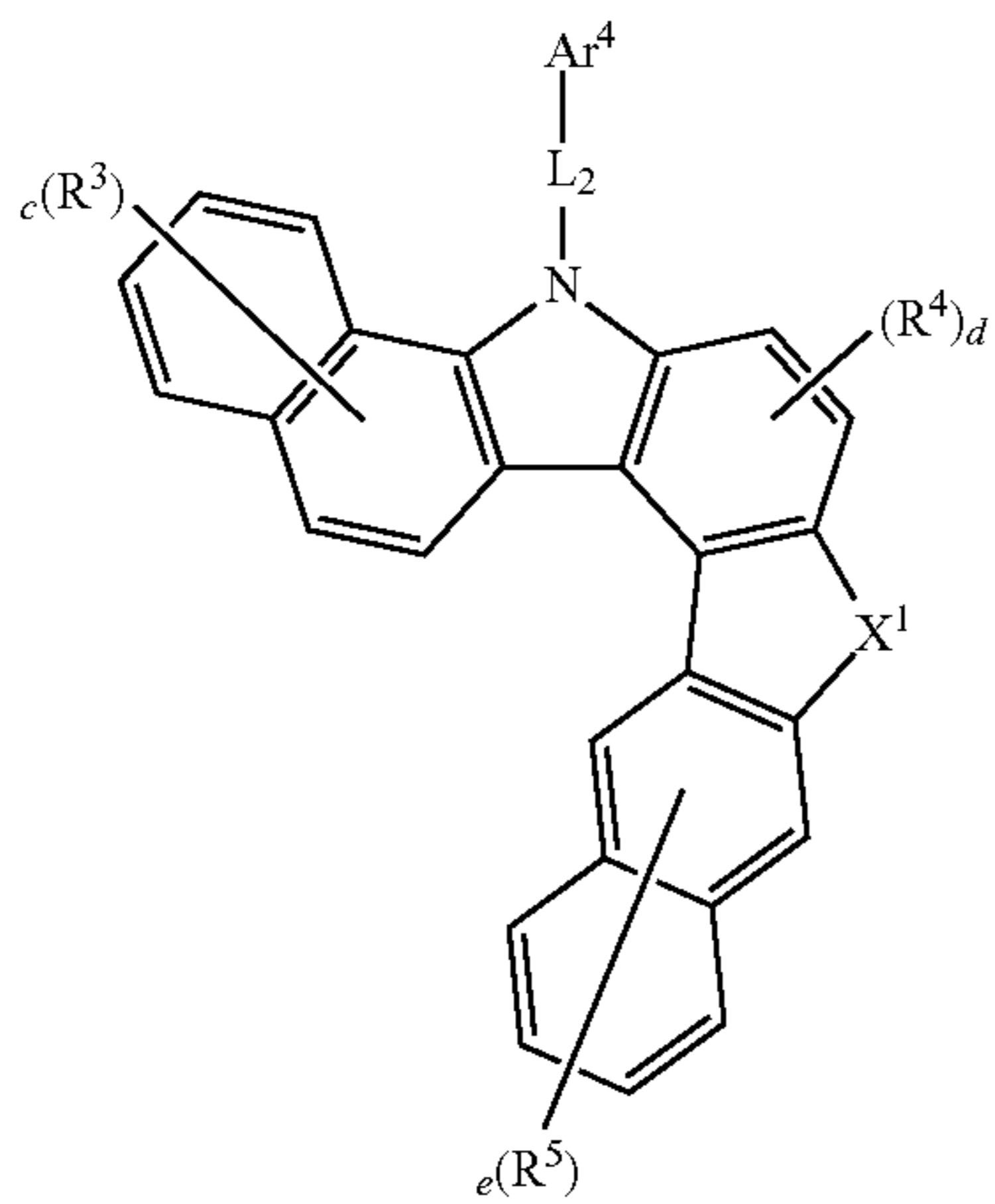
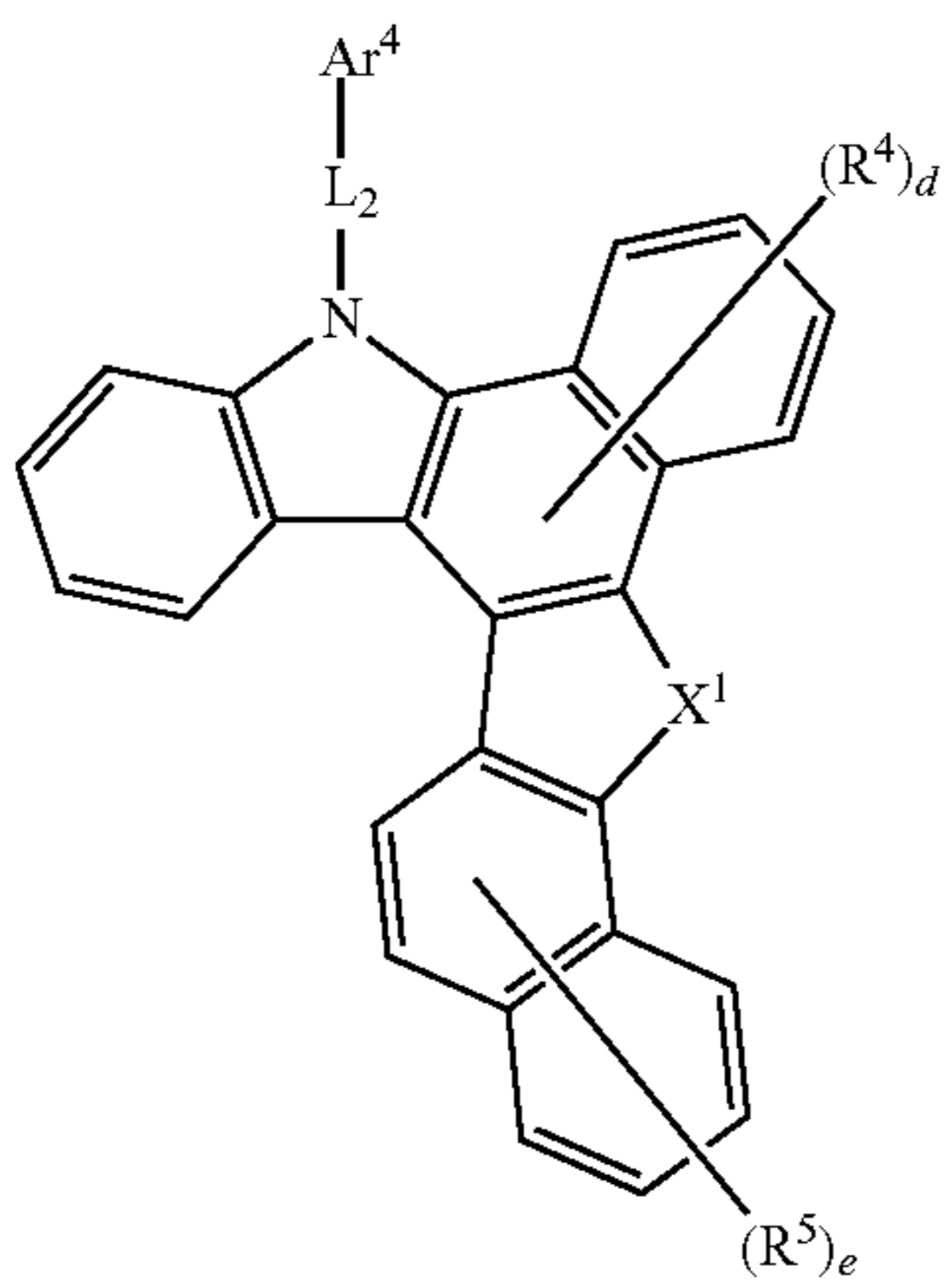
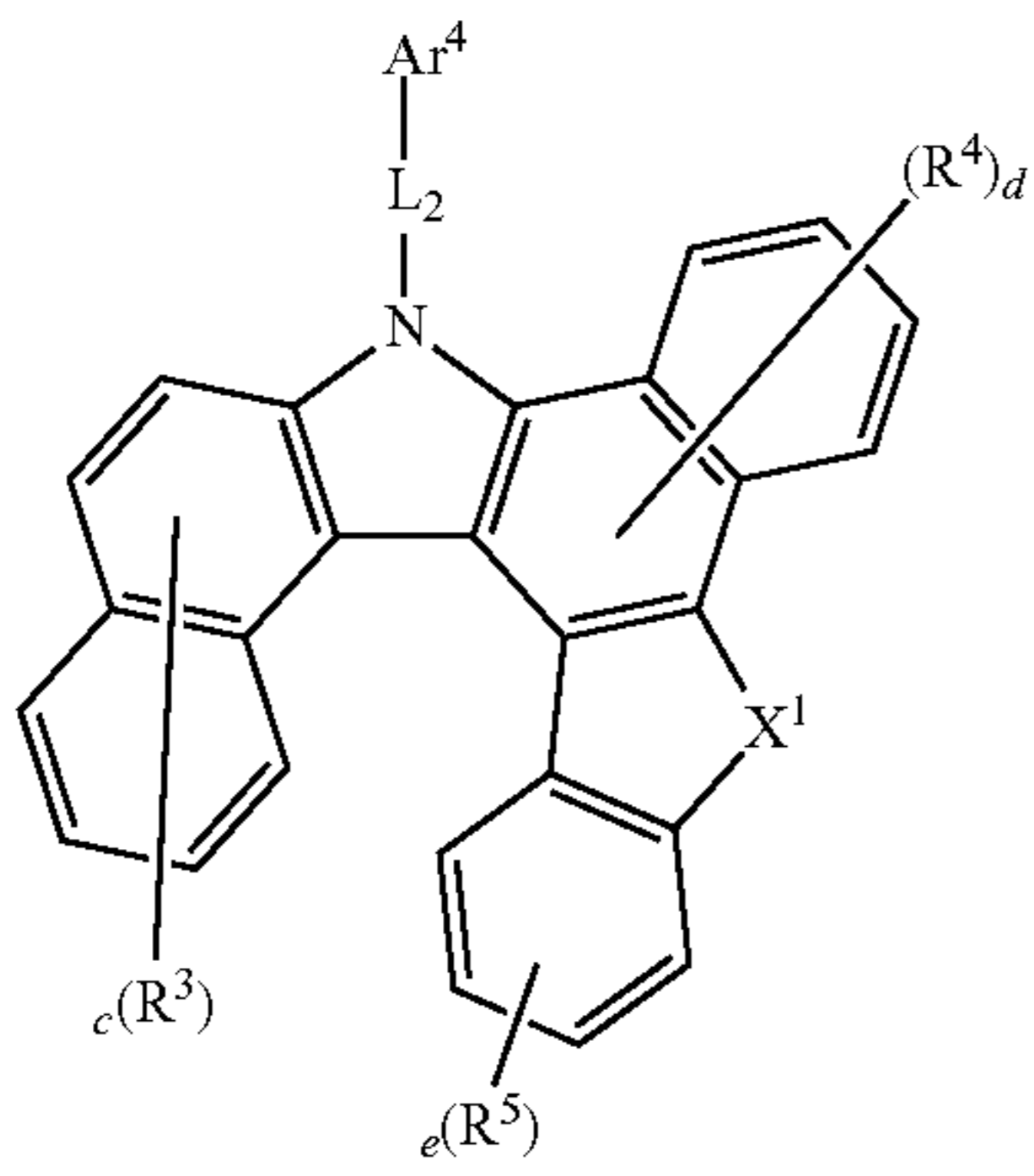
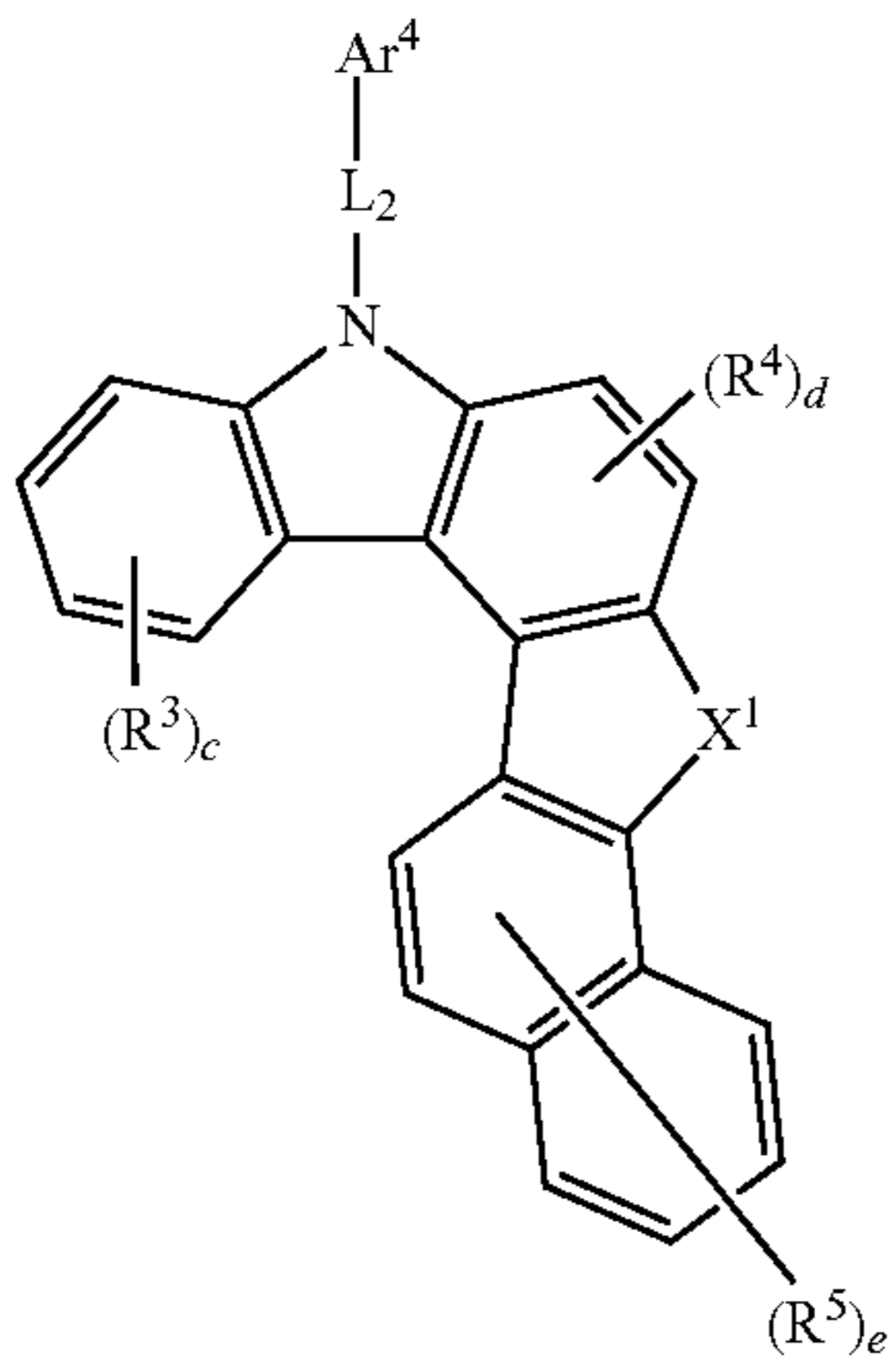
Formula (33)



Formula (34)

**185**

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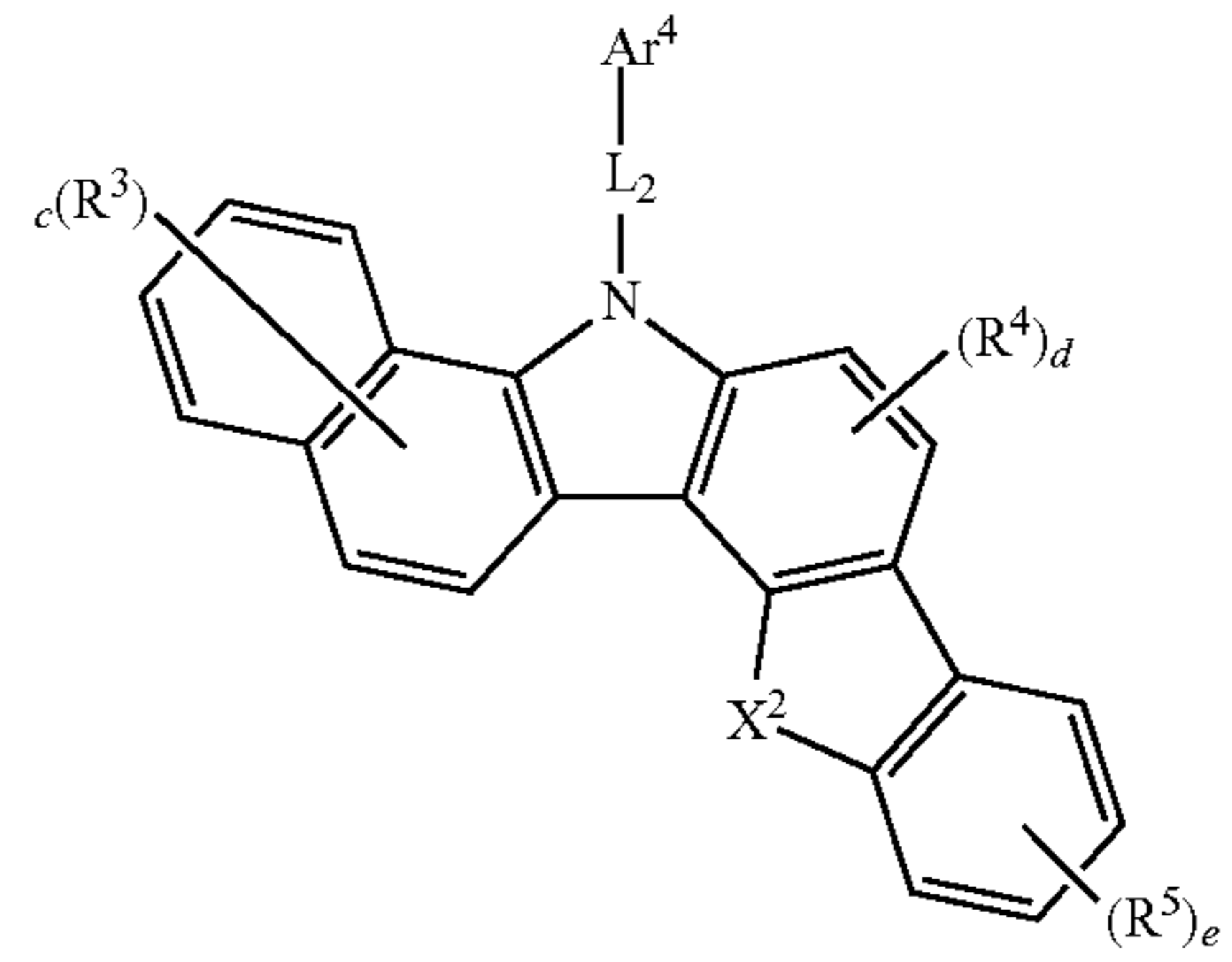


**186**

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Formula (35)

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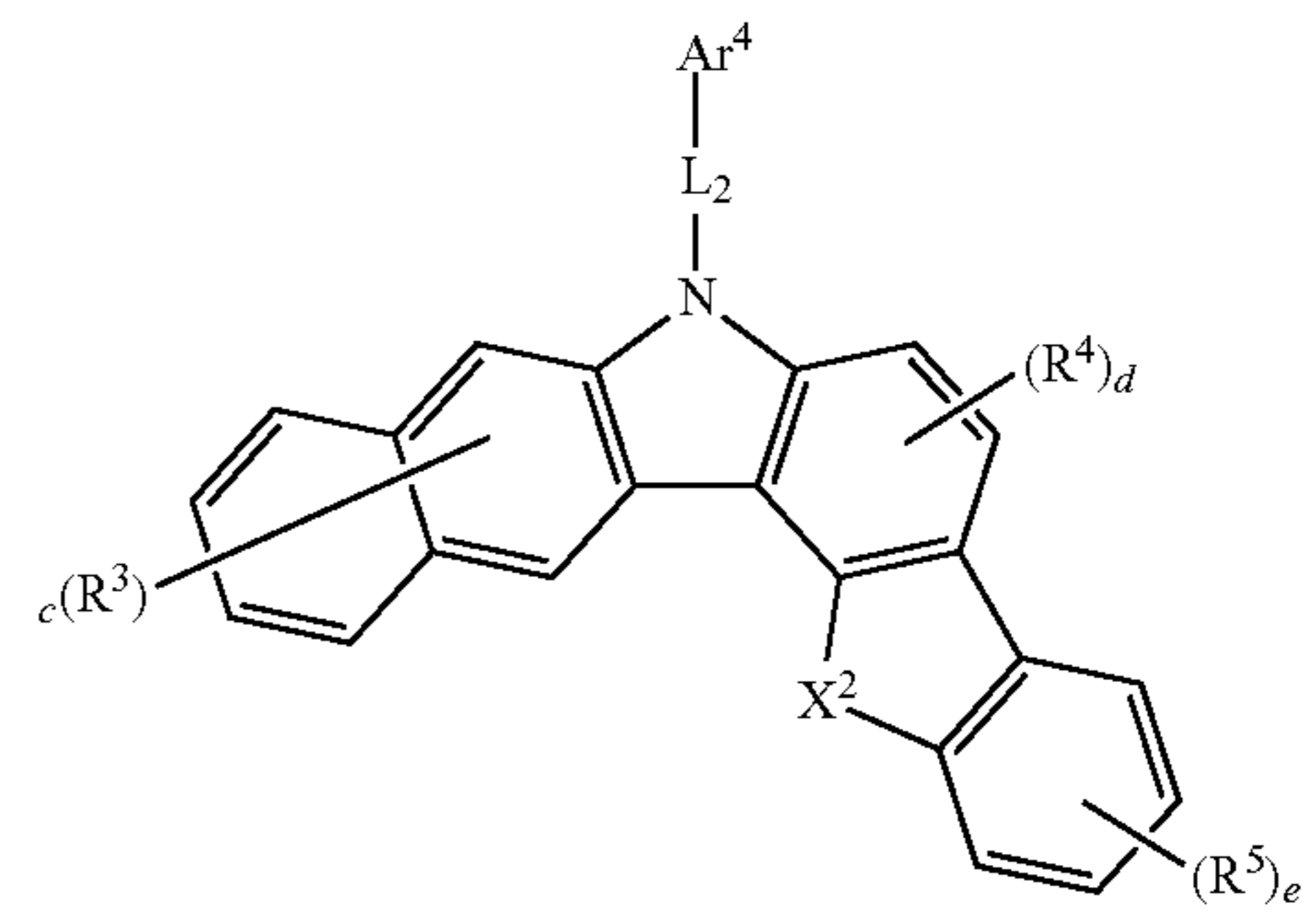
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Formula (39)

Formula (36)

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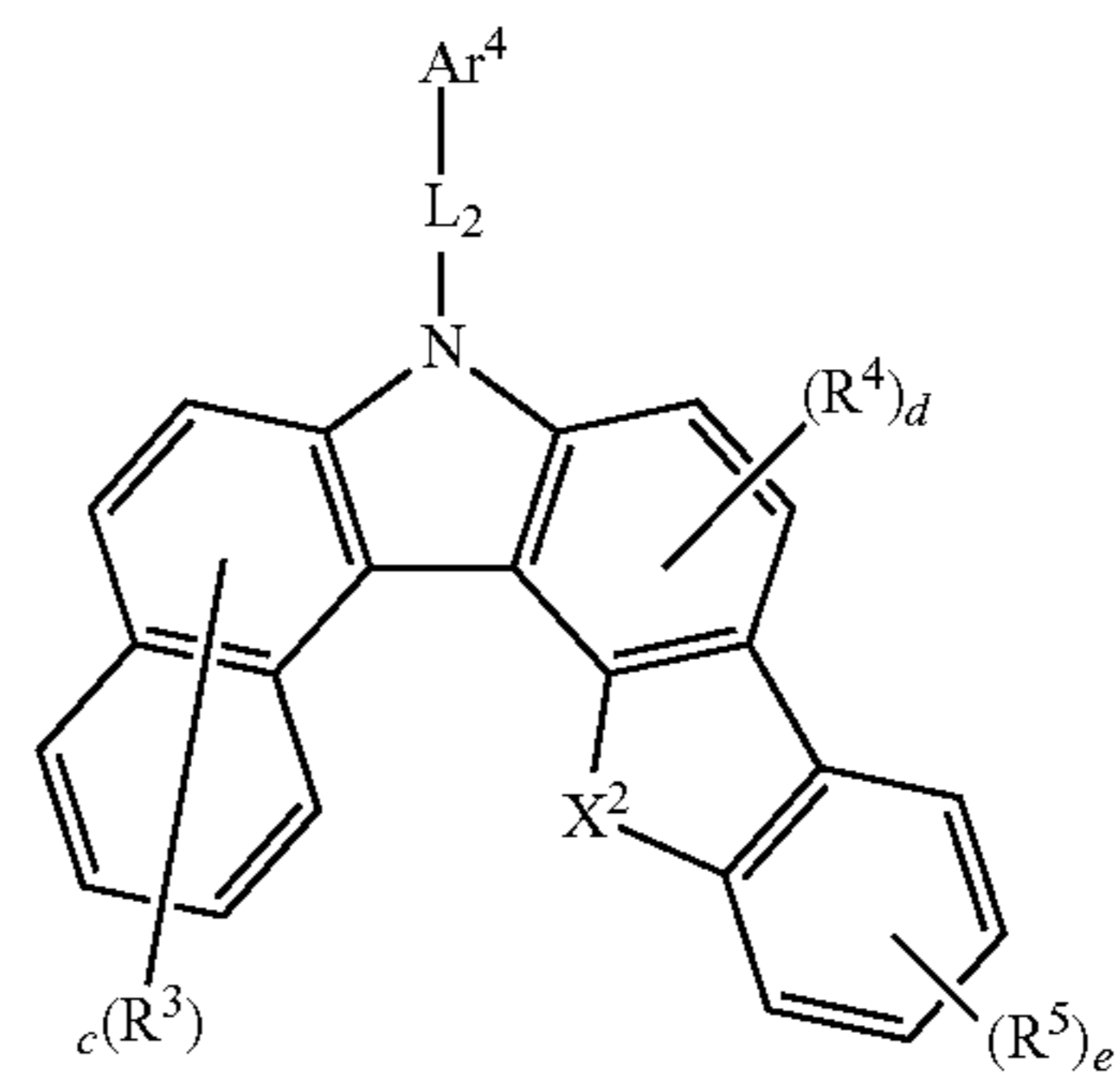
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Formula (40)

Formula (37)

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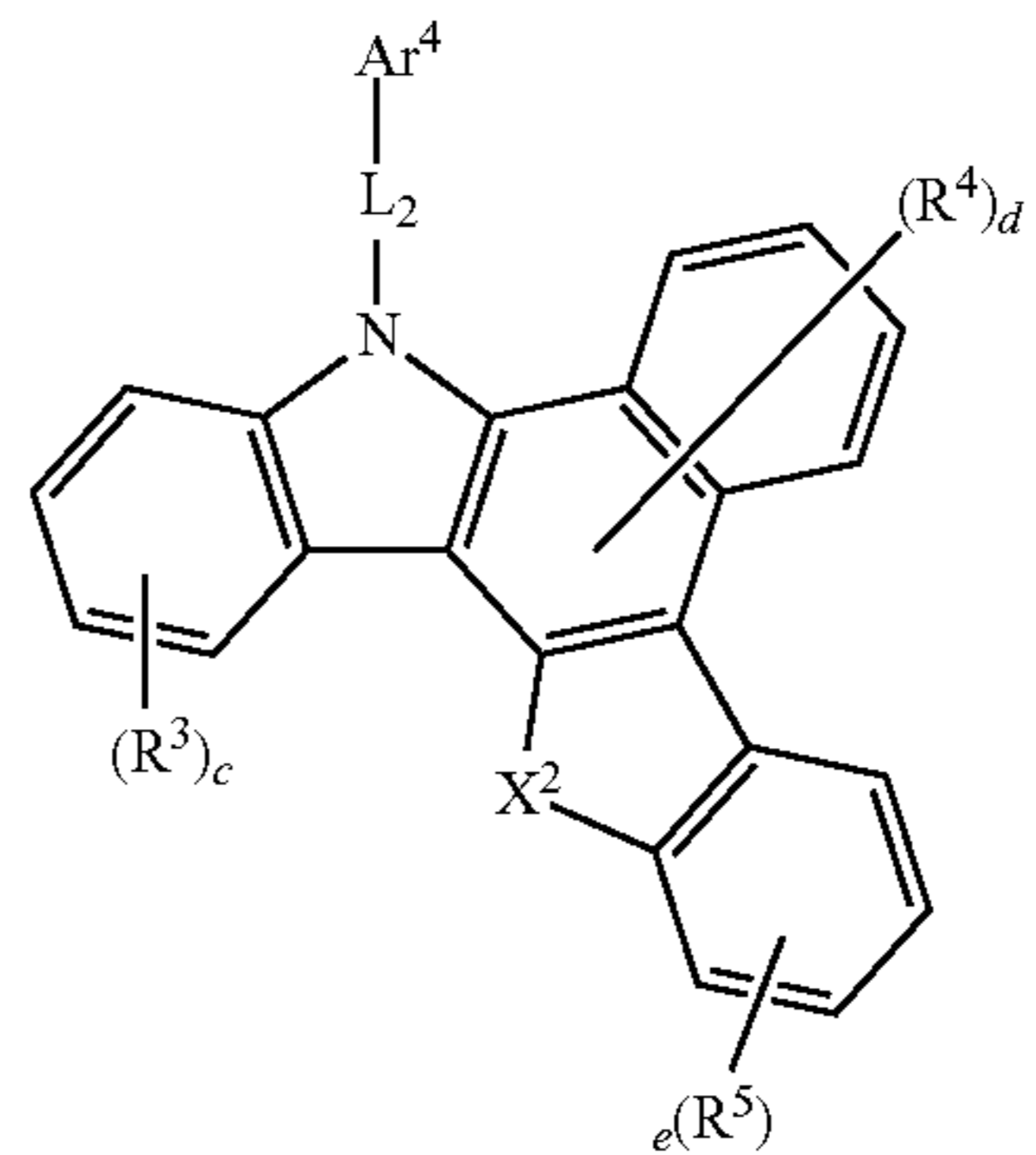
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Formula (41)

Formula (38)

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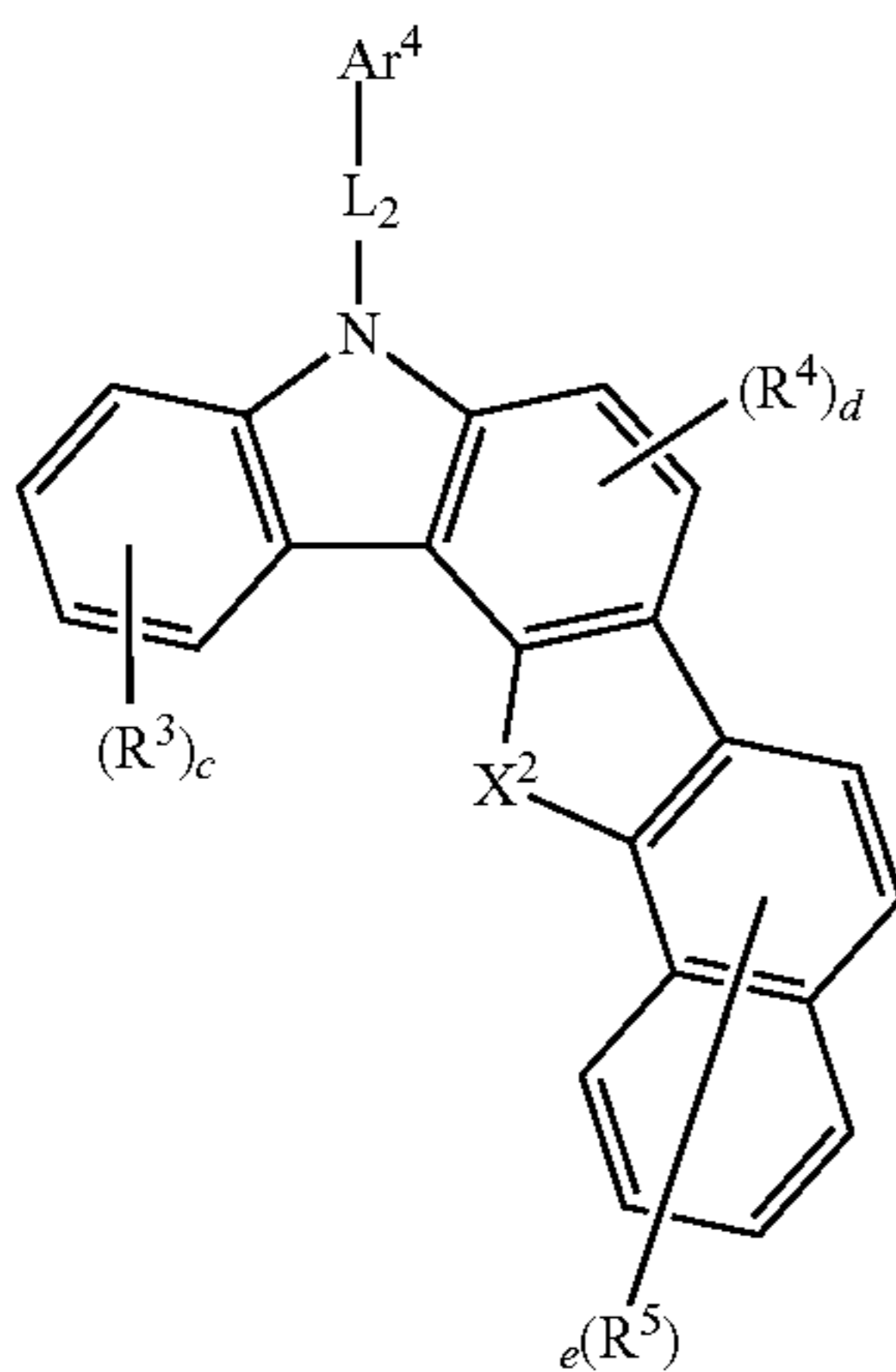
65

Formula (42)



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-continued



Formula (43)

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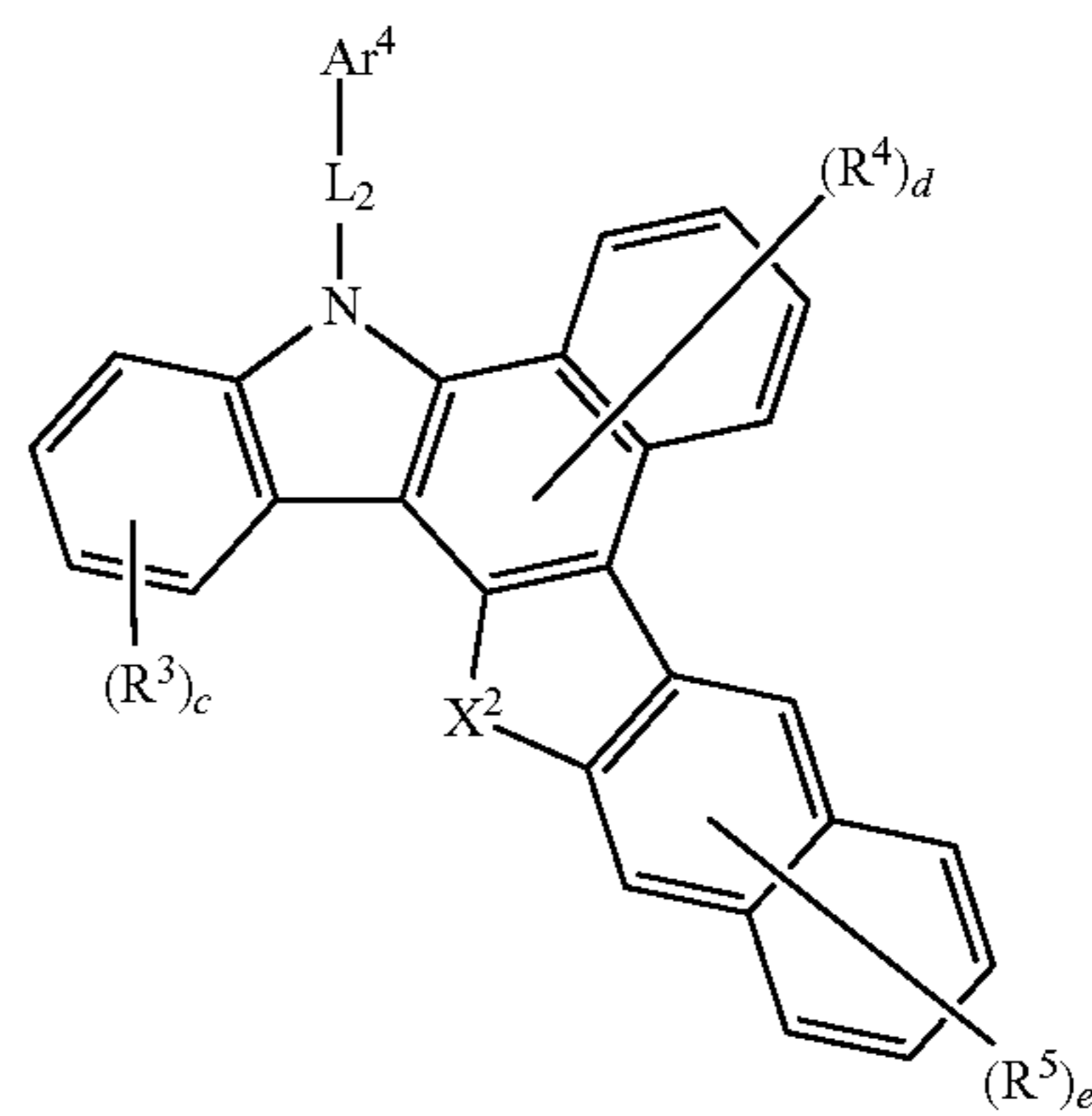
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188

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Formula (47)

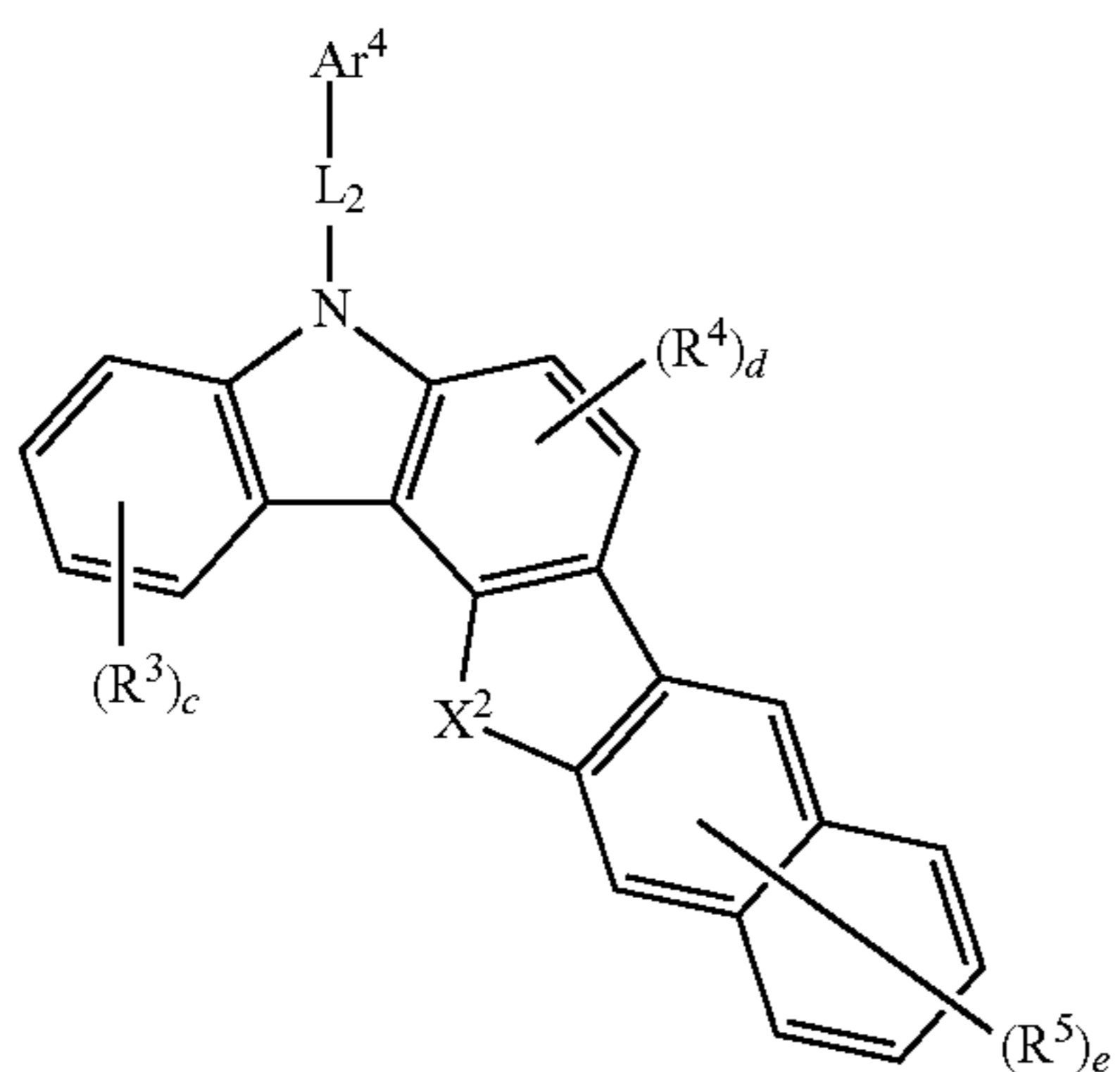
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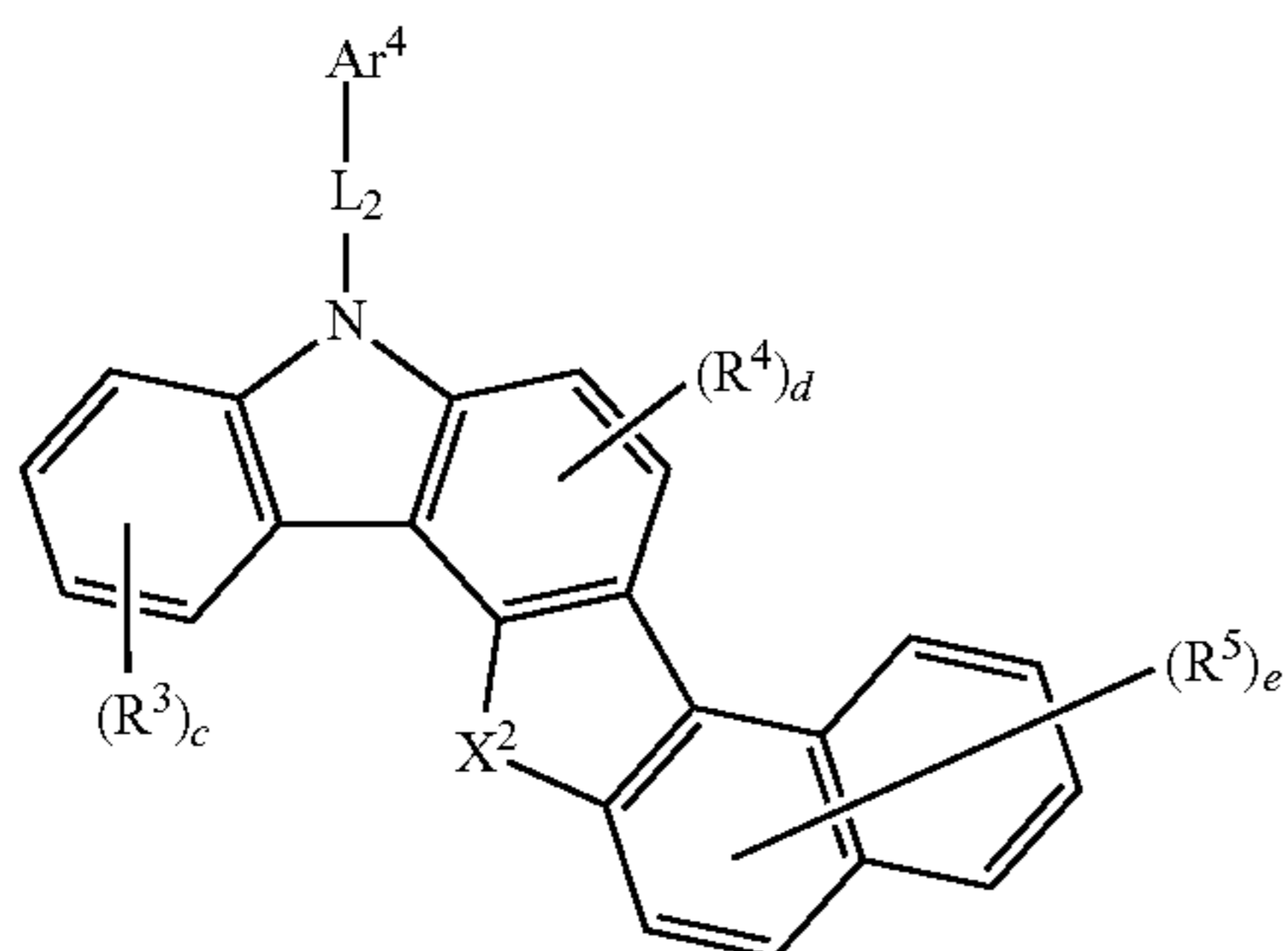
40

Formula (44)



Formula (48)

Formula (45)



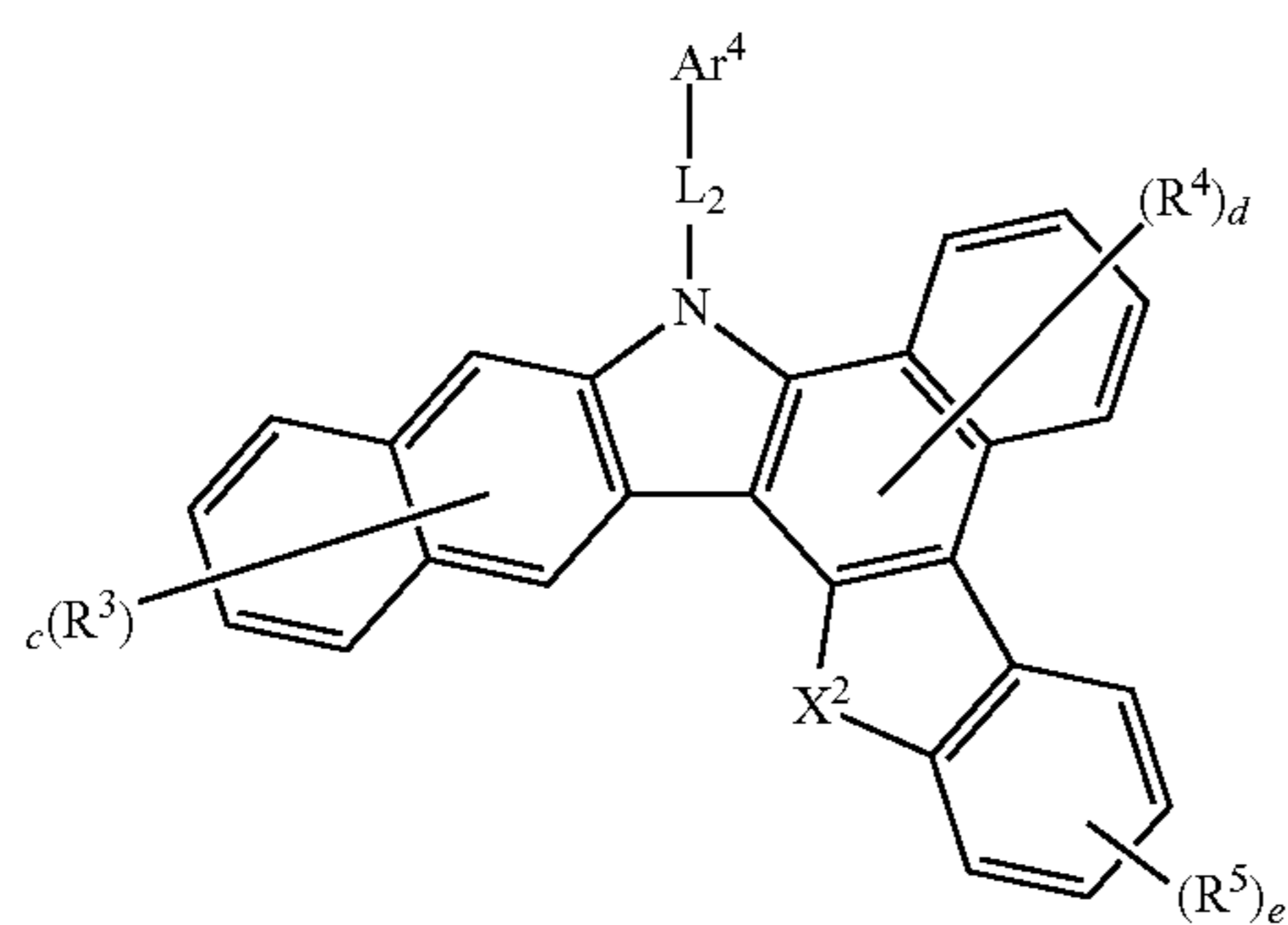
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wherein Ar<sup>4</sup>, L<sup>2</sup>, X<sup>1</sup>, X<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, c, d, and e are the same as defined in claim 1.

13. The organic electric element according to claim 1, wherein the second host compound represented by Formula (2) comprises any of compound represented by the following Formulas (49) to (55):

Formula (46)

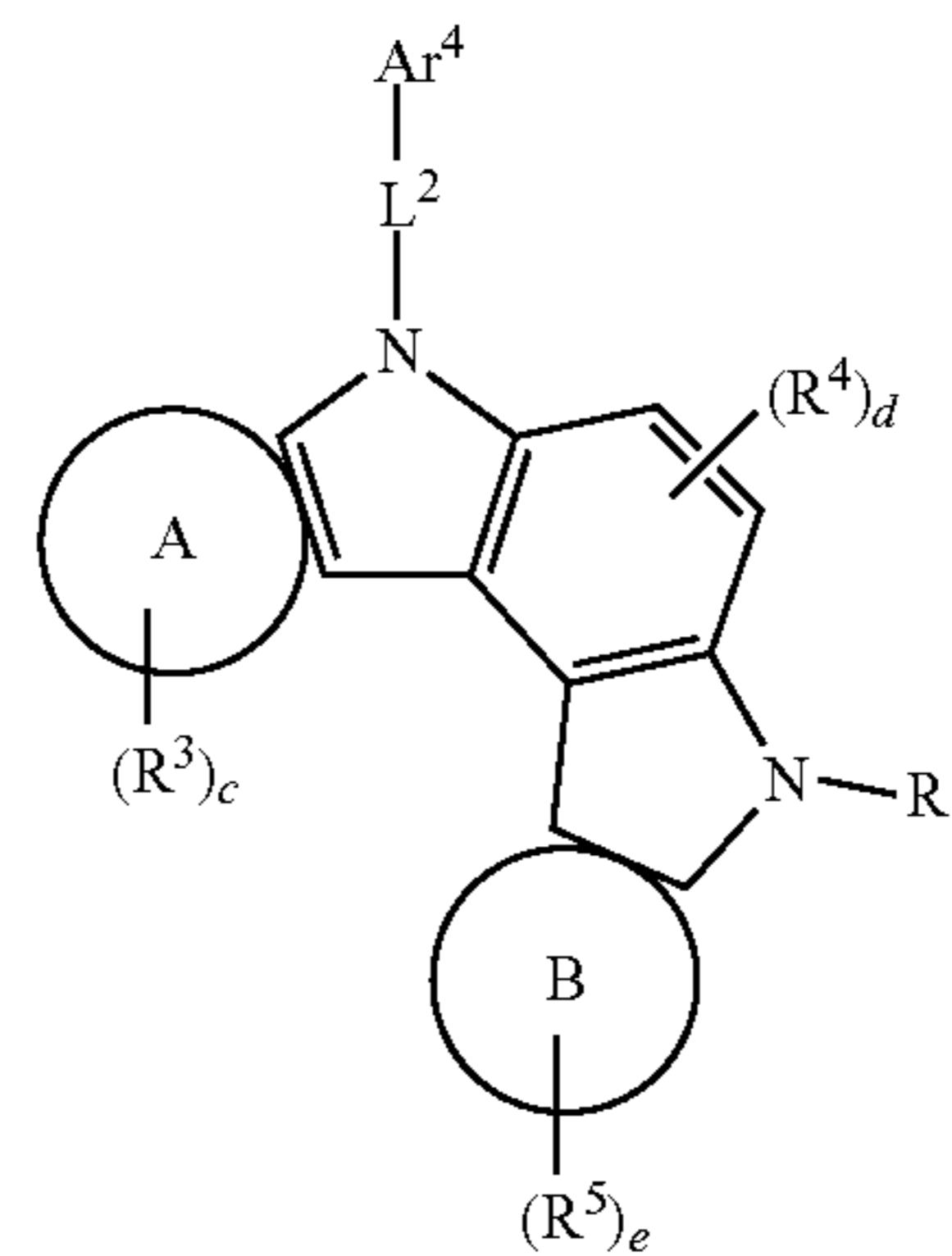


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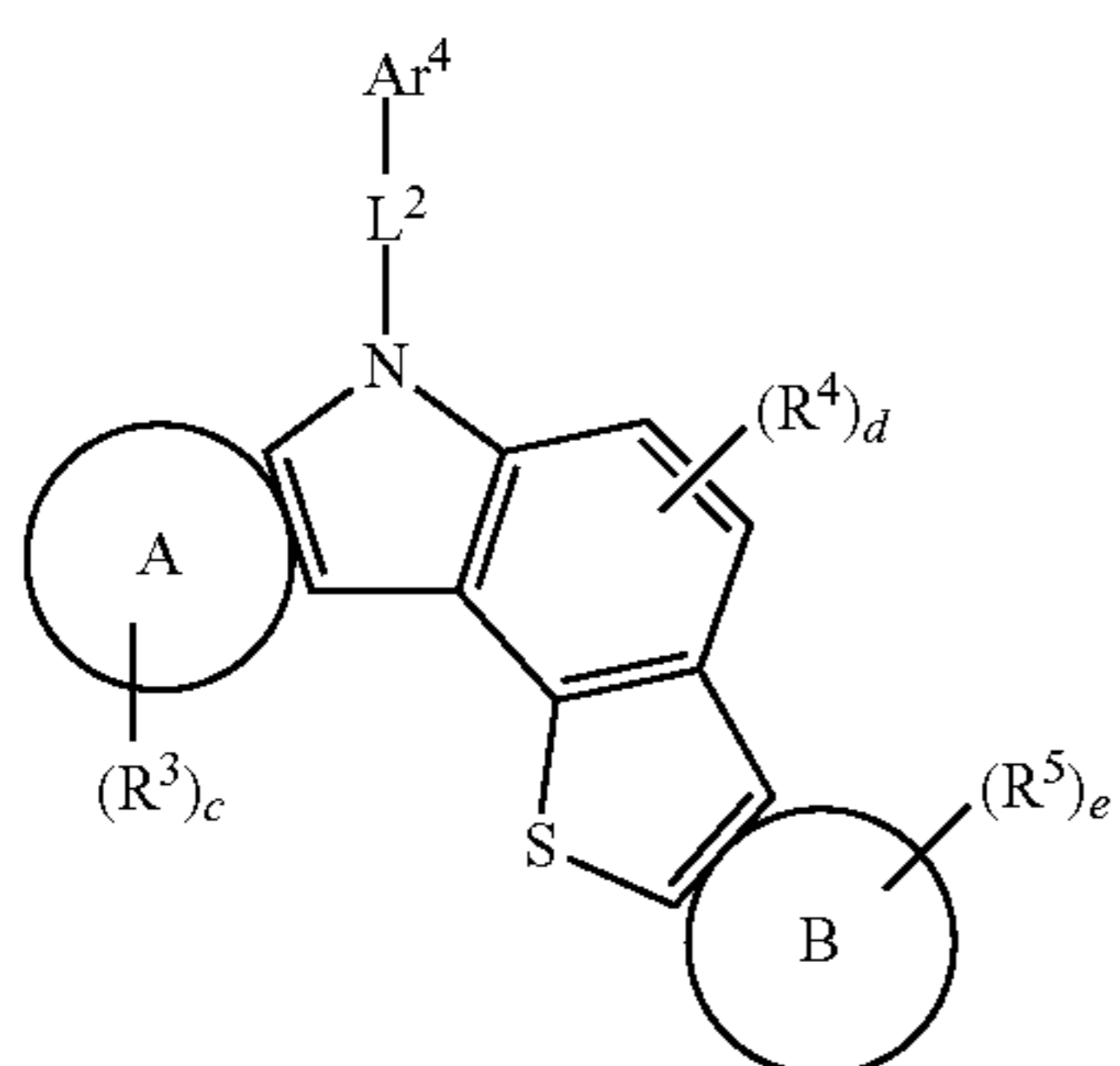
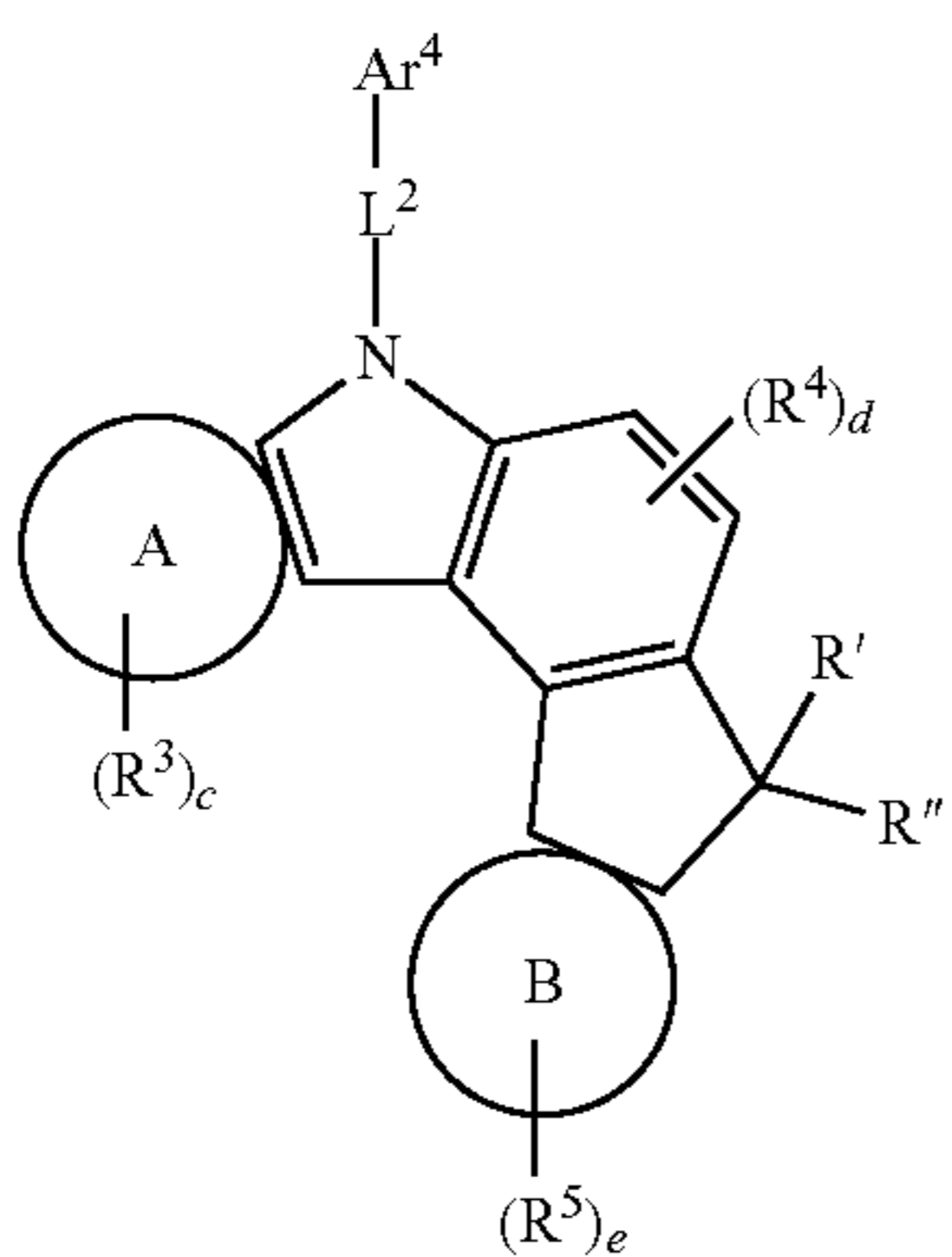
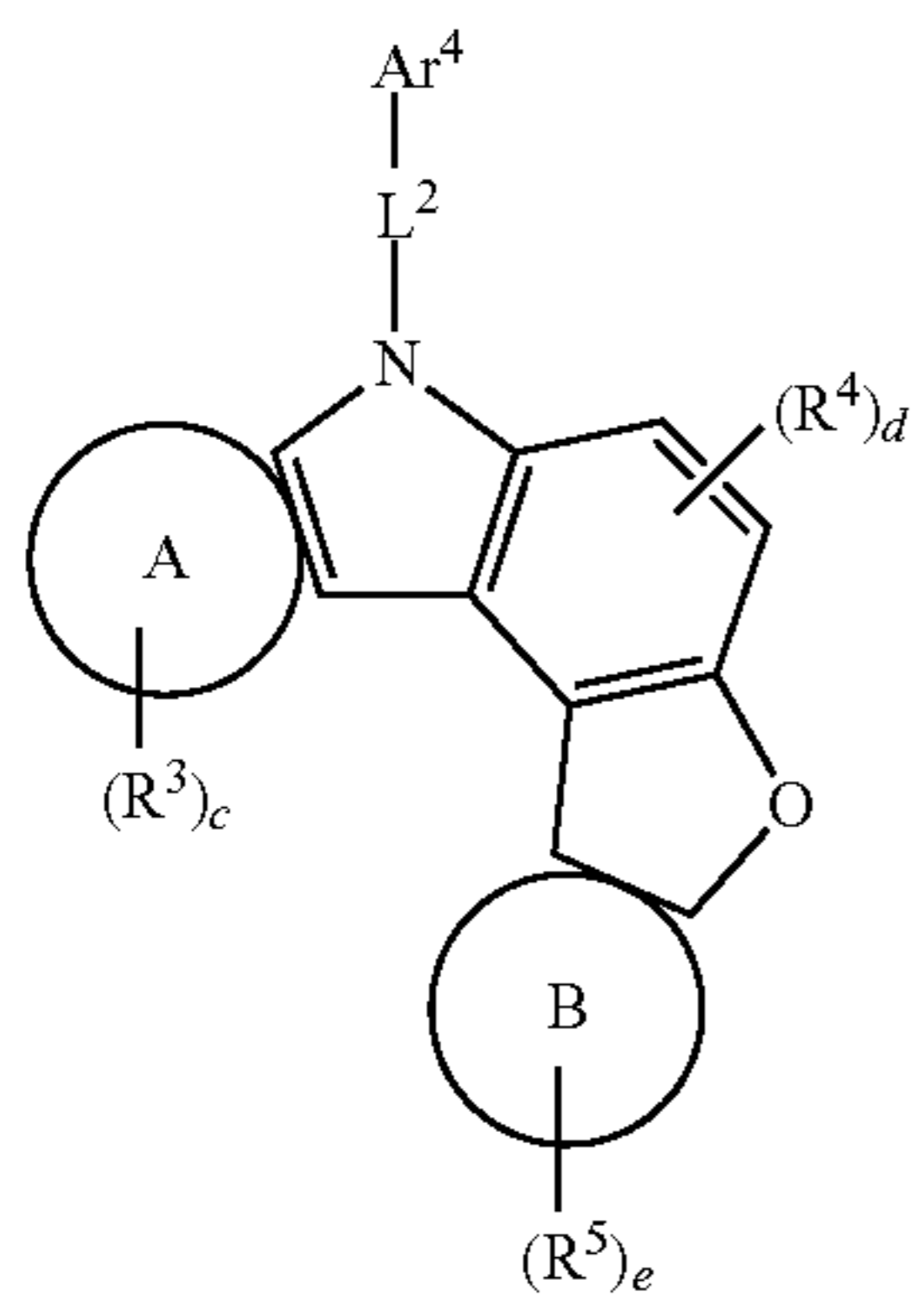
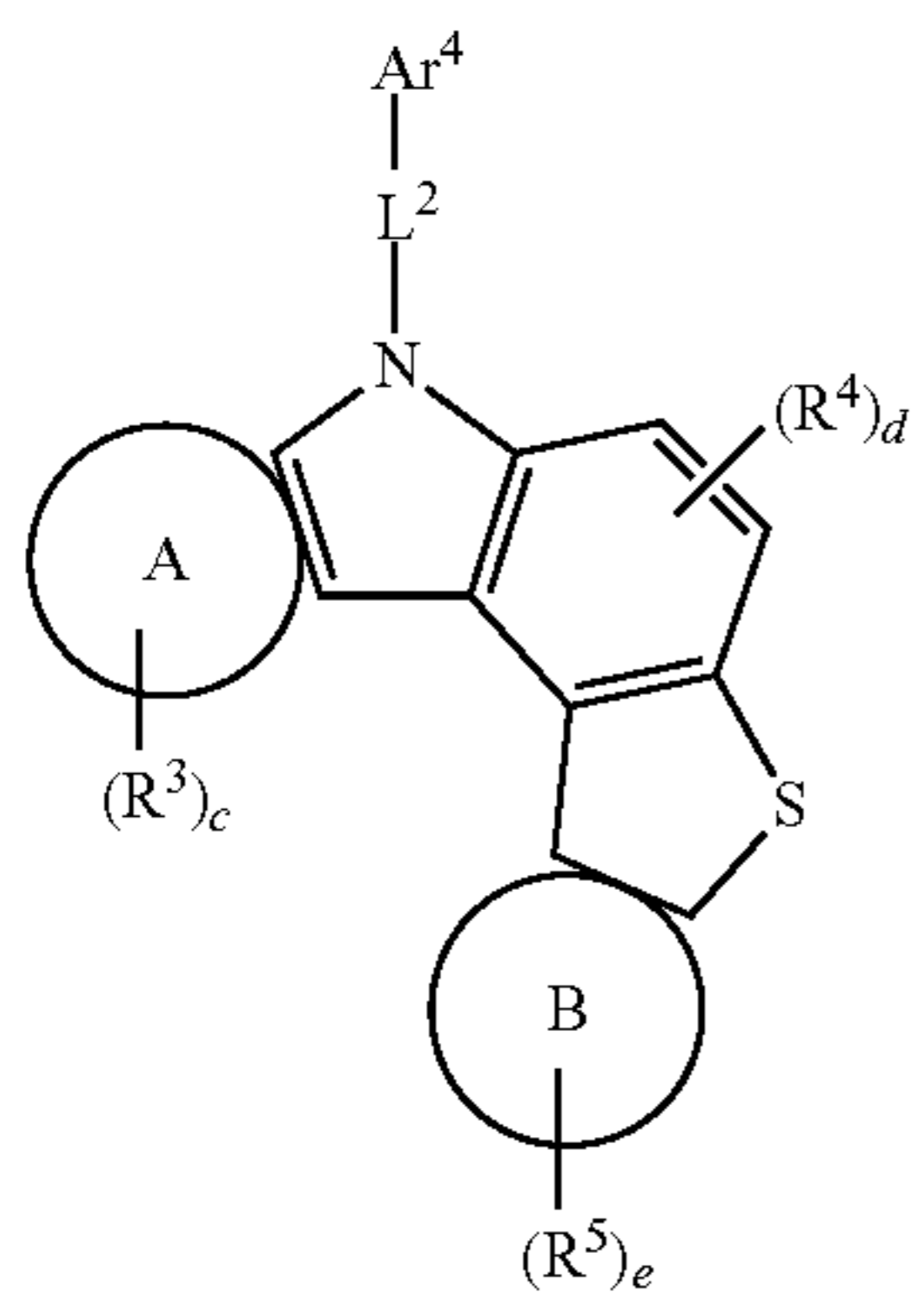
65

Formula (49)



189

-continued



190

-continued

Formula (50)

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Formula (51) 20

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Formula (52)

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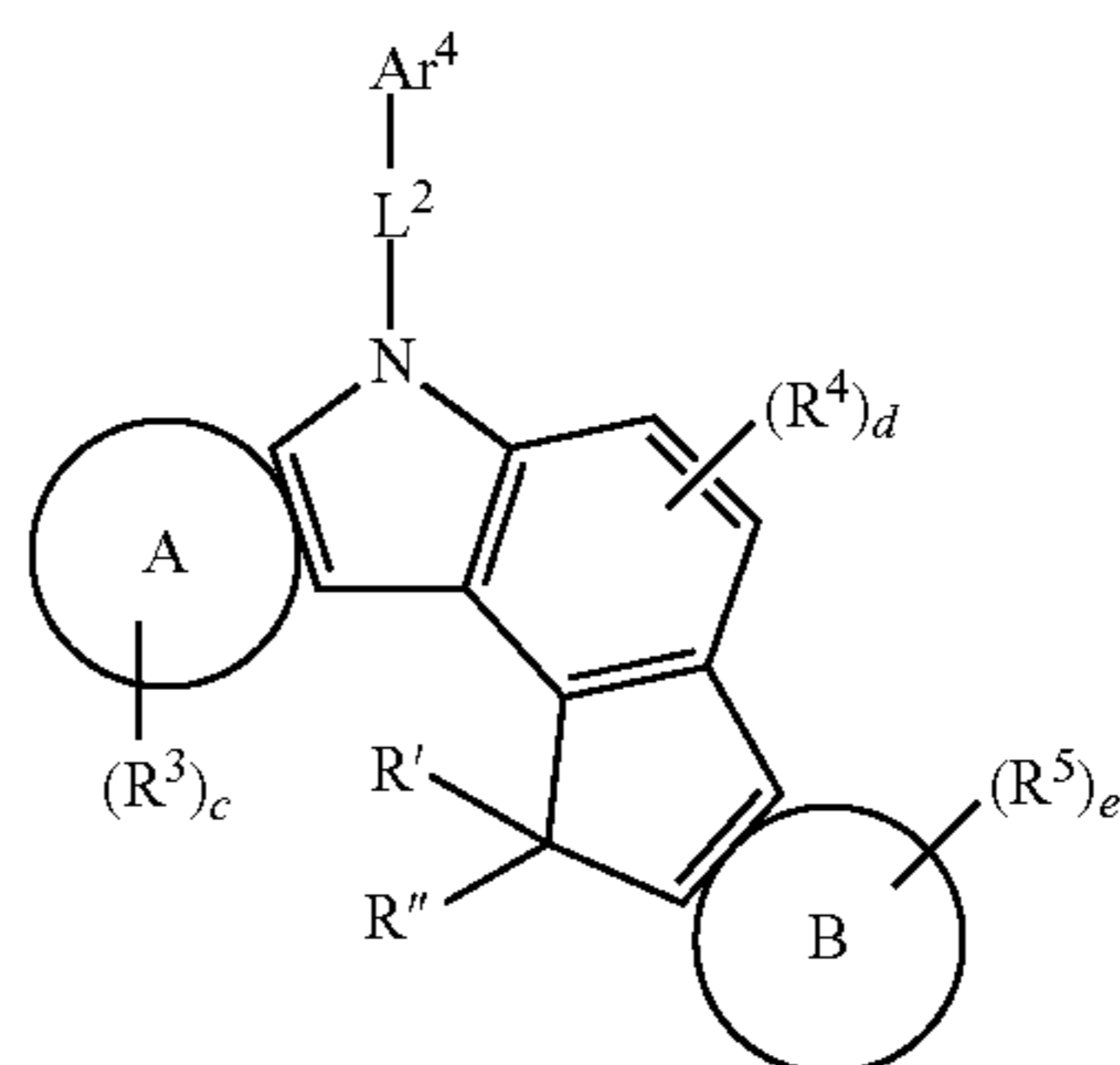
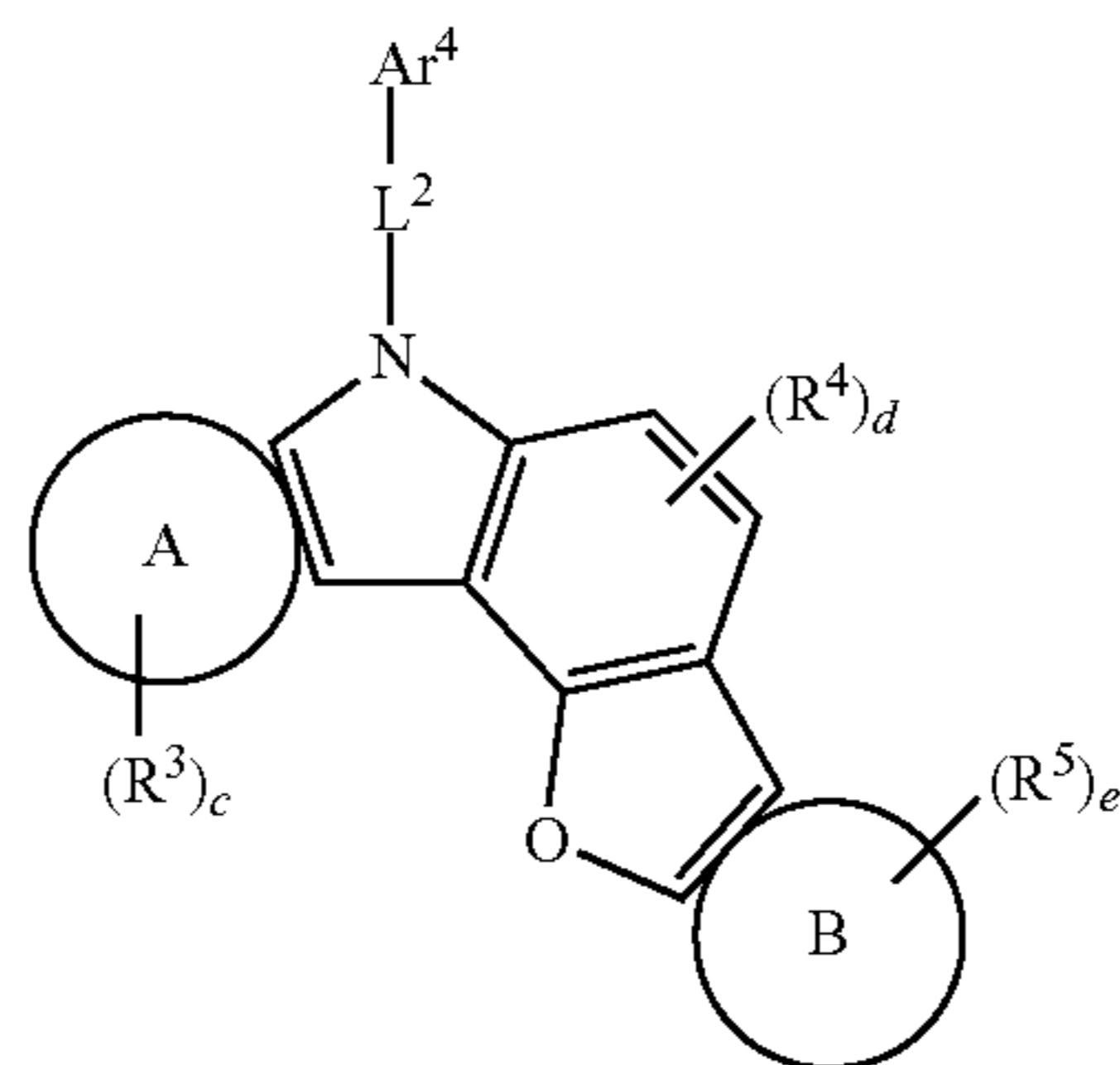
Formula (53)

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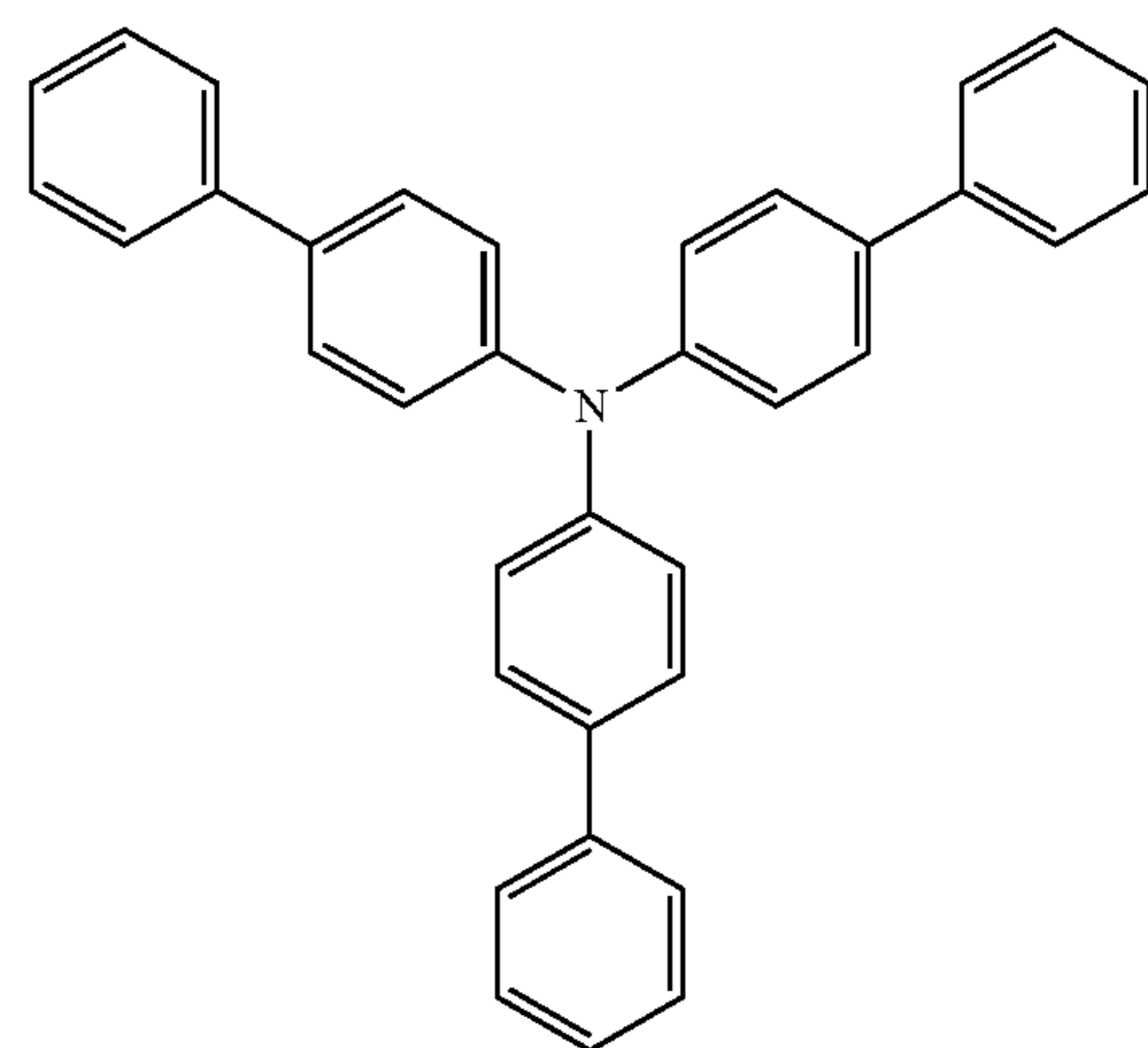
Formula (54)



Formula (55)

wherein  $R^3$ ,  $R^4$ ,  $R^5$ ,  $Ar^4$ ,  $L^2$ ,  $c$ ,  $d$ ,  $e$ ,  $A$ ,  $B$ ,  $R'$  and  $R''$  are the same as defined in claim 1.

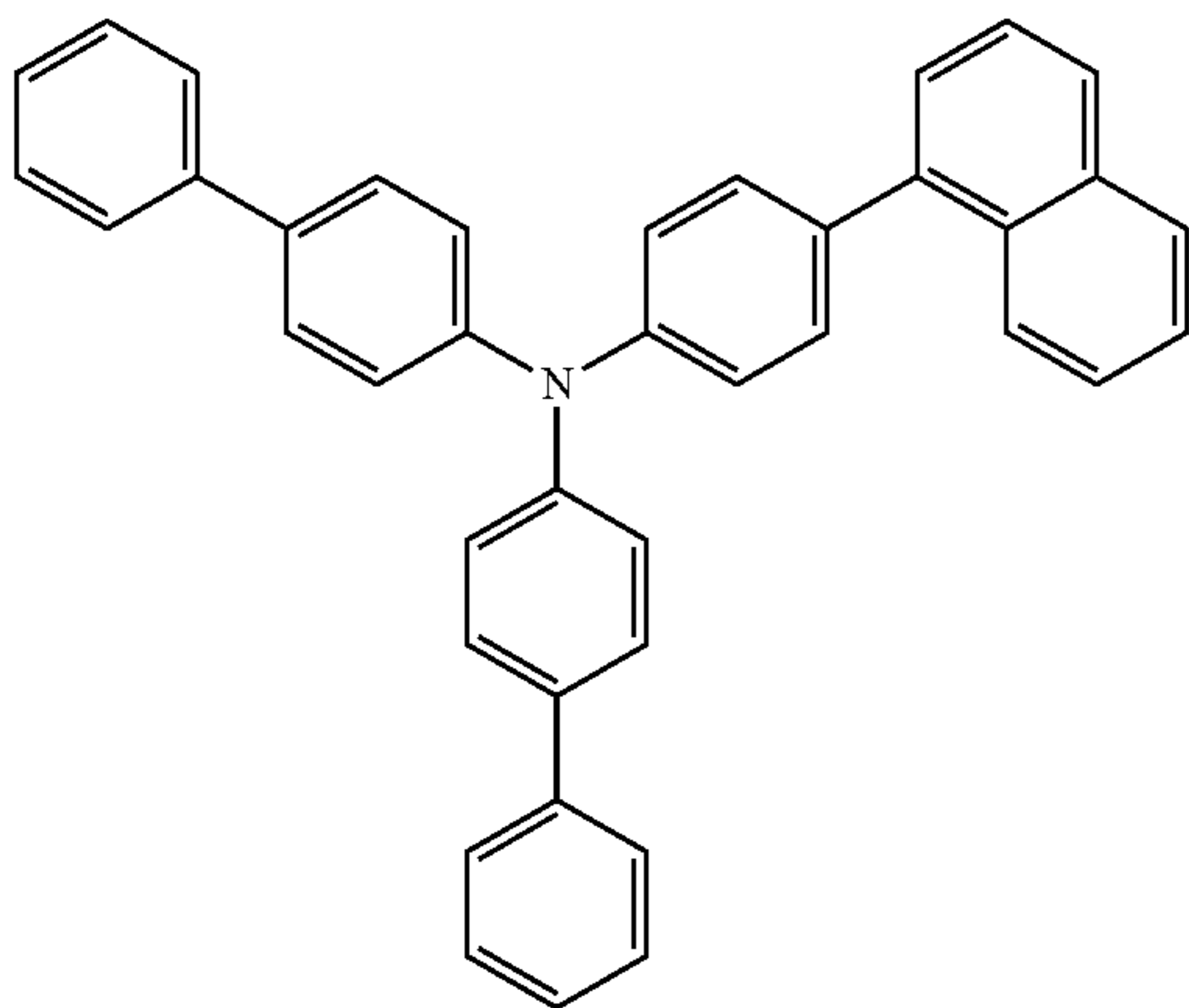
14. The organic electric element according to claim 1, wherein the first host compound represented by Formula (1) is one of the following Compounds 1-1' to 1-82':



1-1'

**191**

-continued



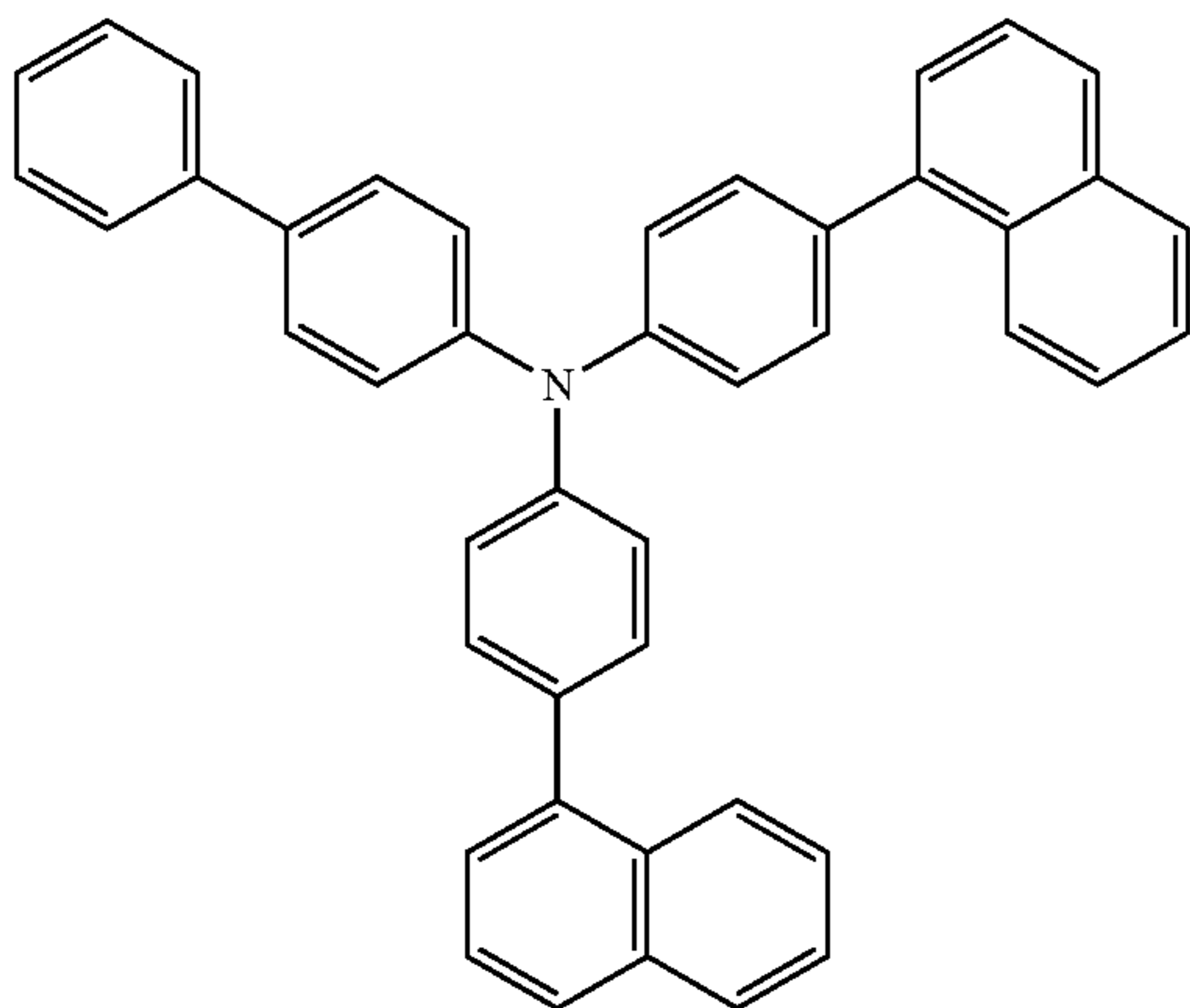
1-2'

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1-3'

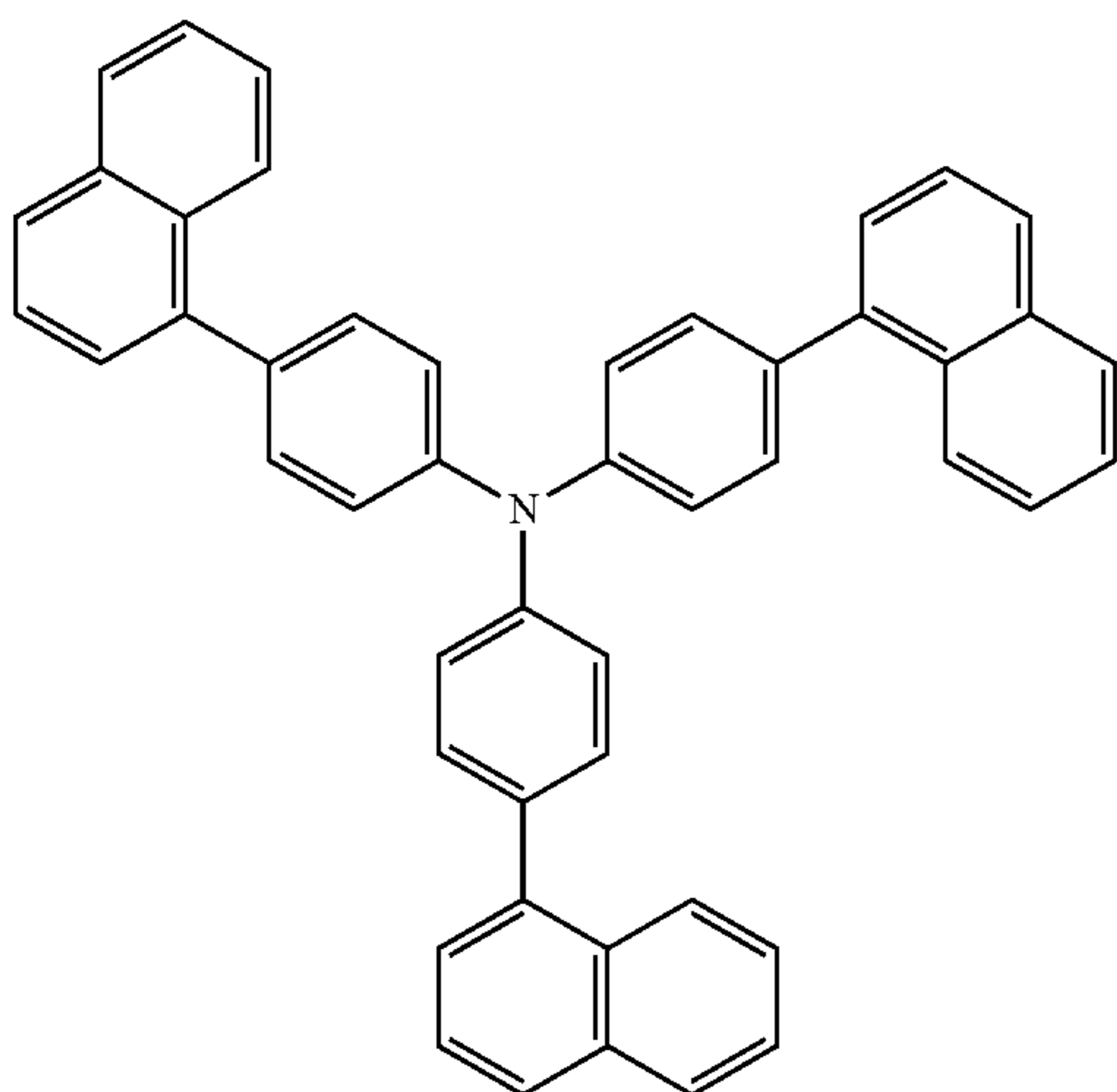
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1-4'

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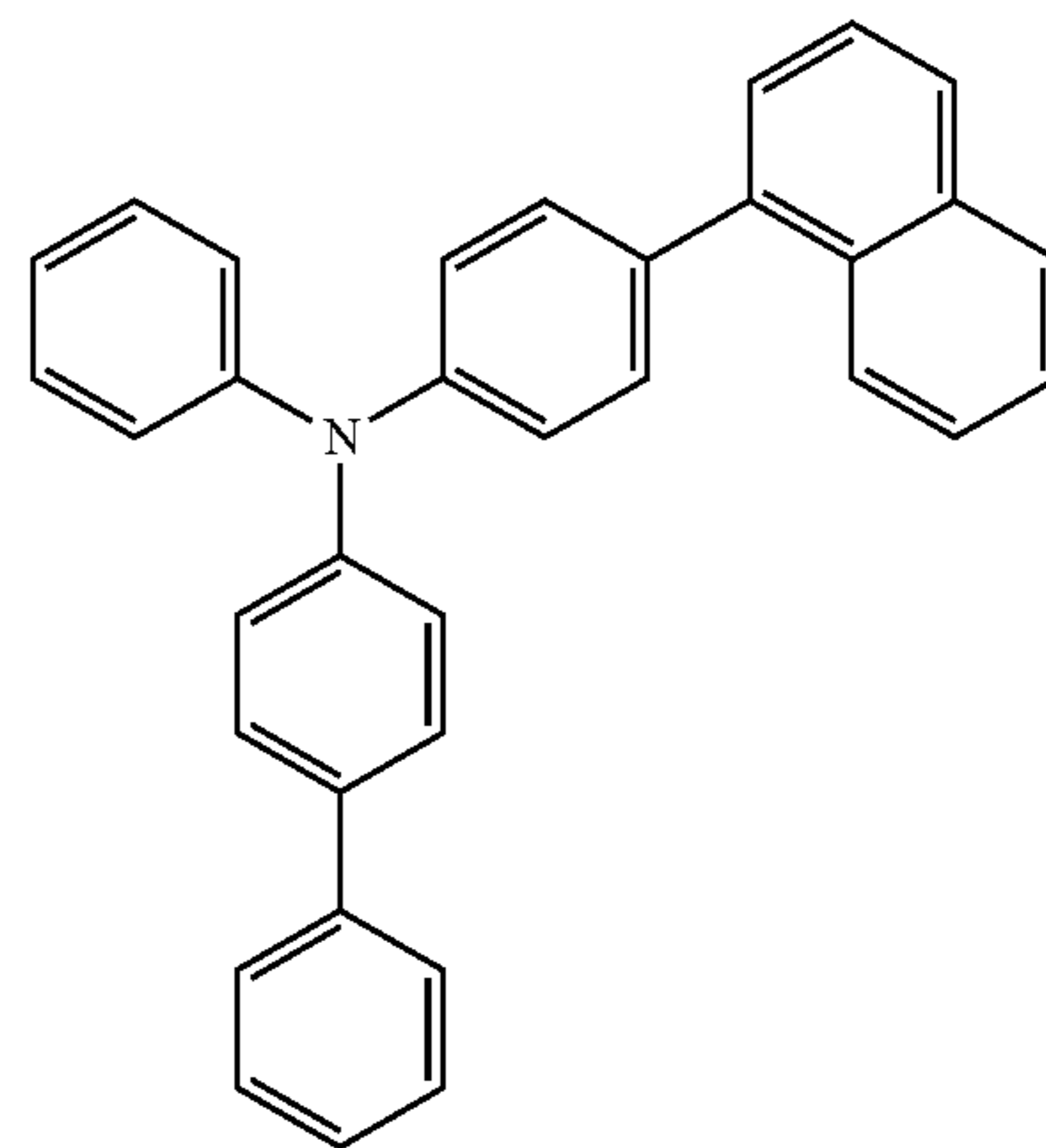
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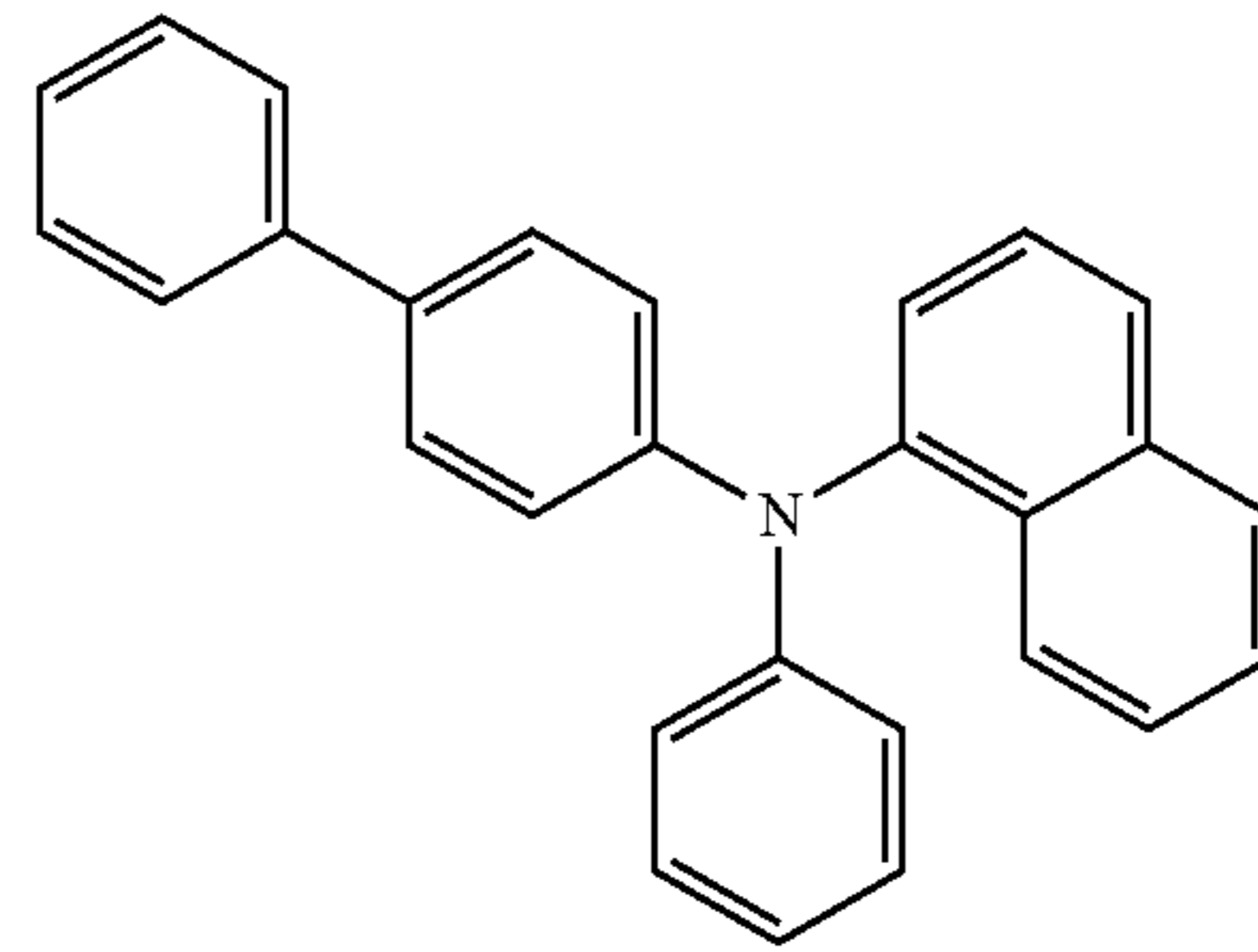
65

**192**

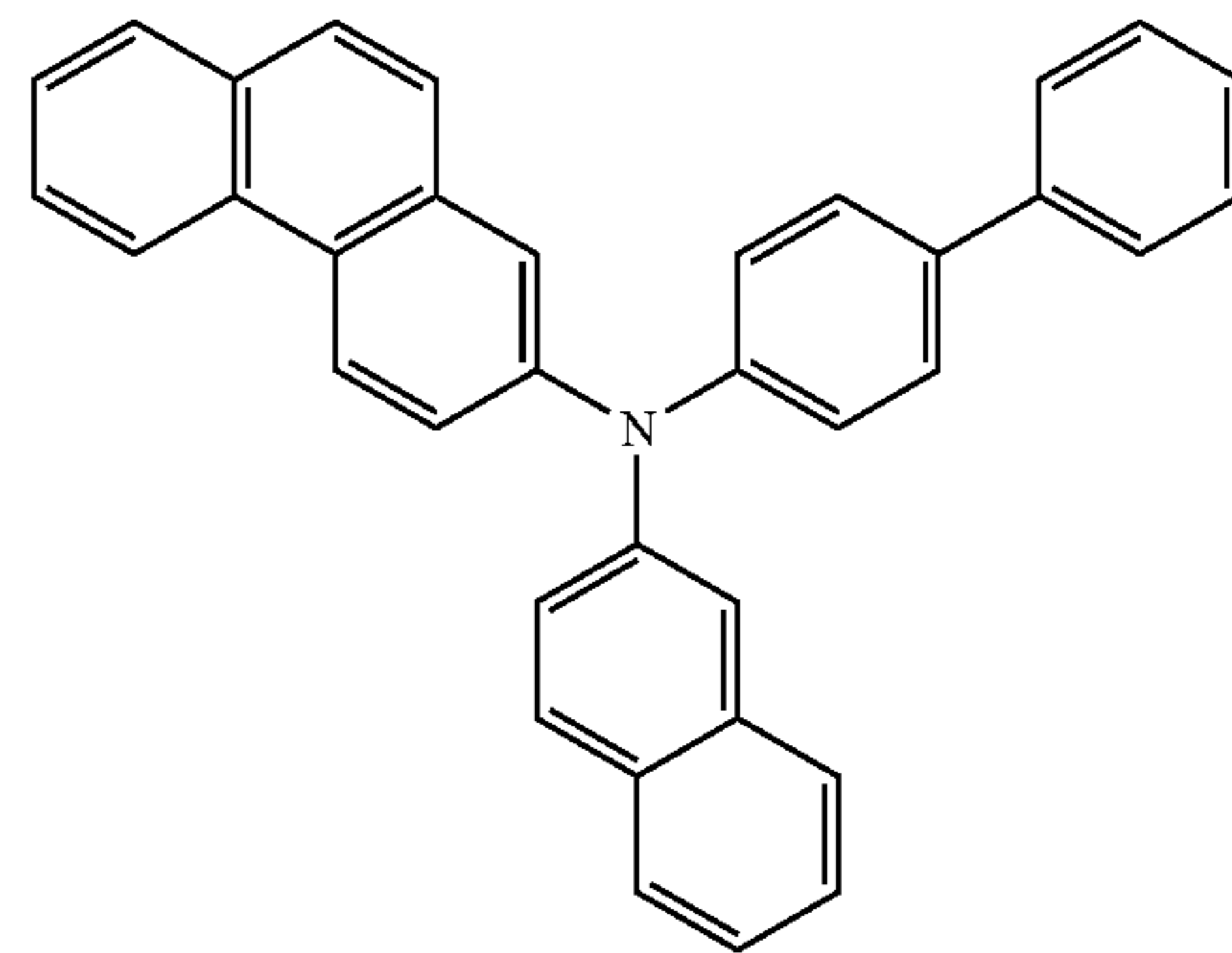
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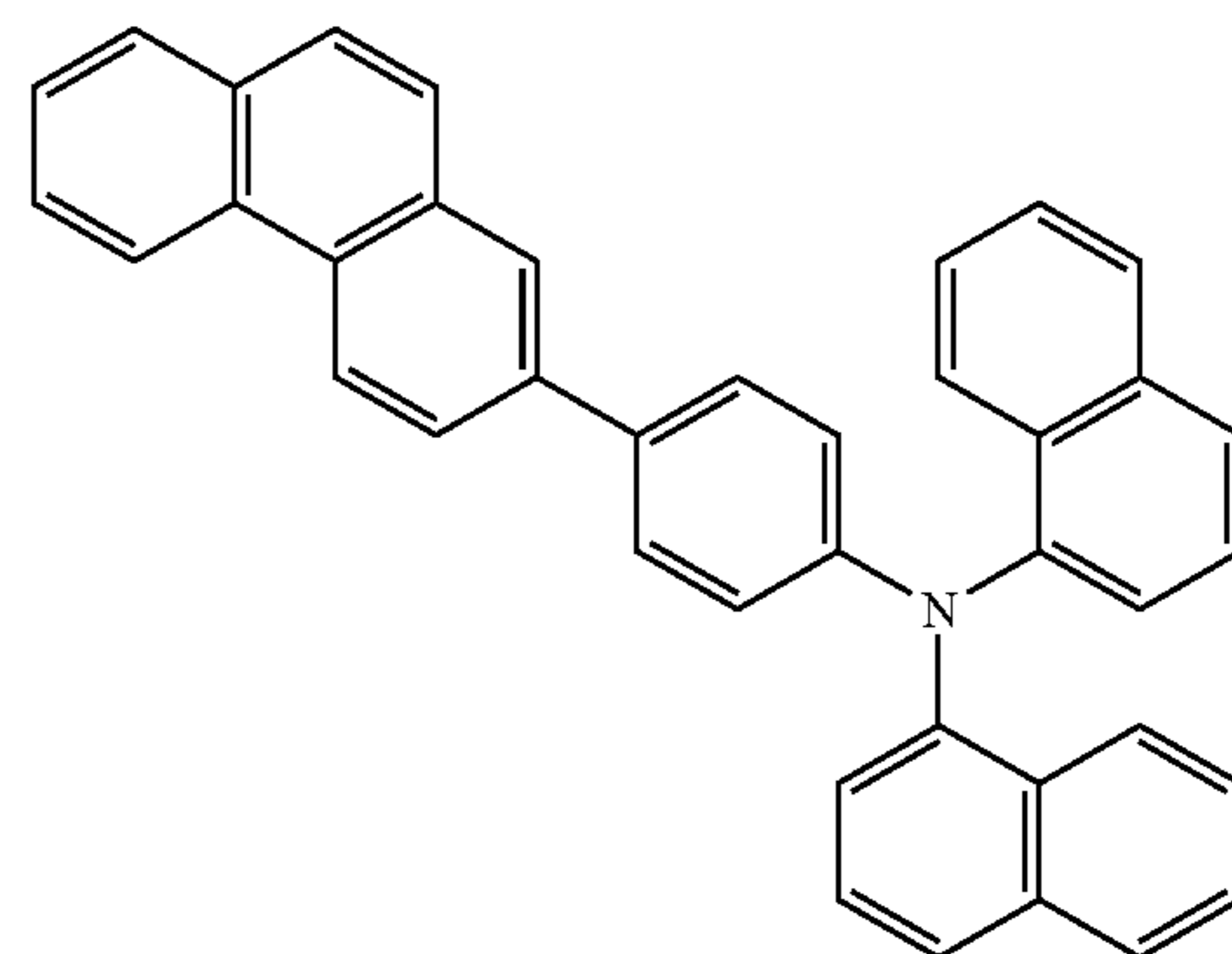
1-5'



1-6'



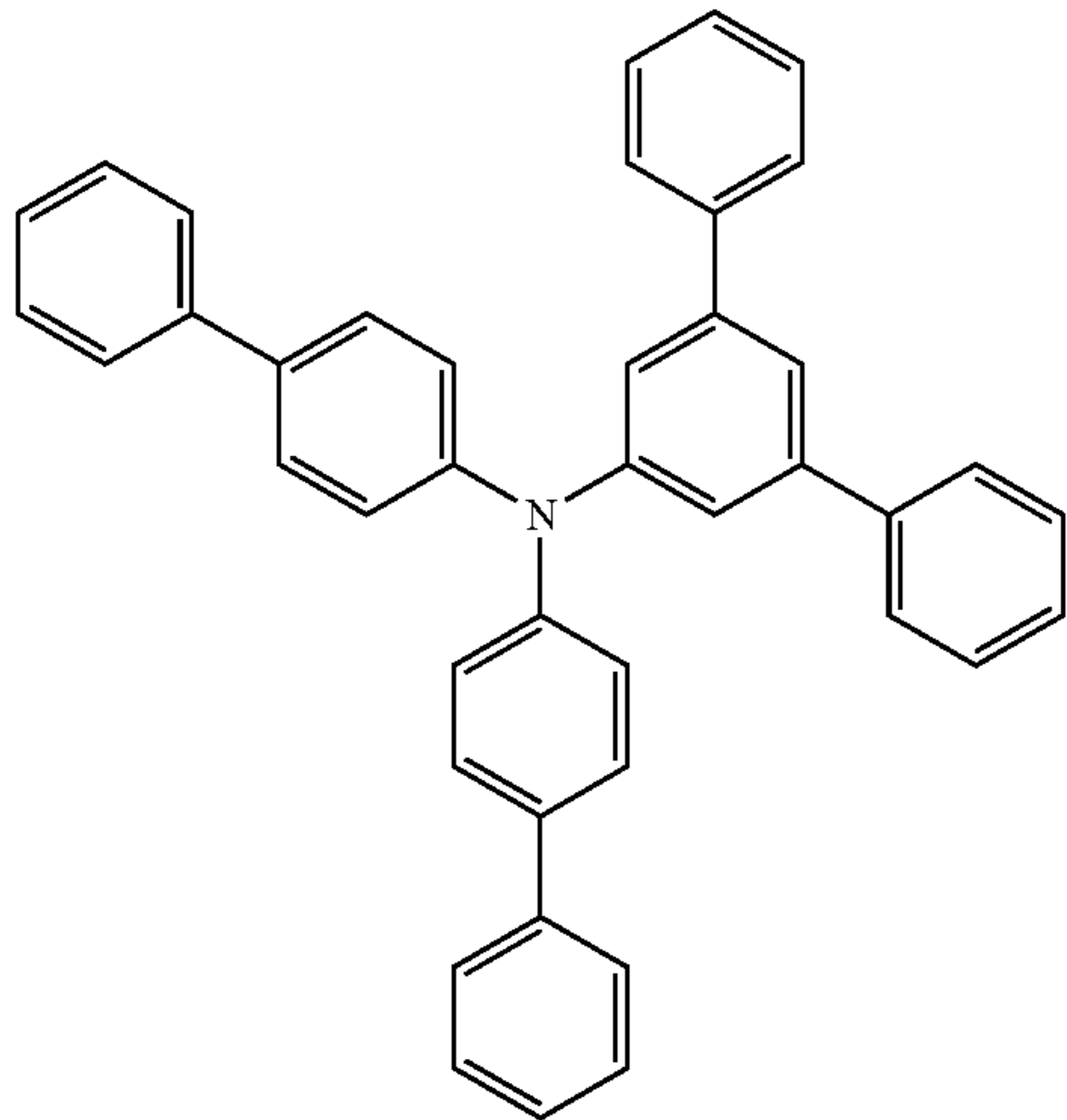
1-7'



1-8'

**193**

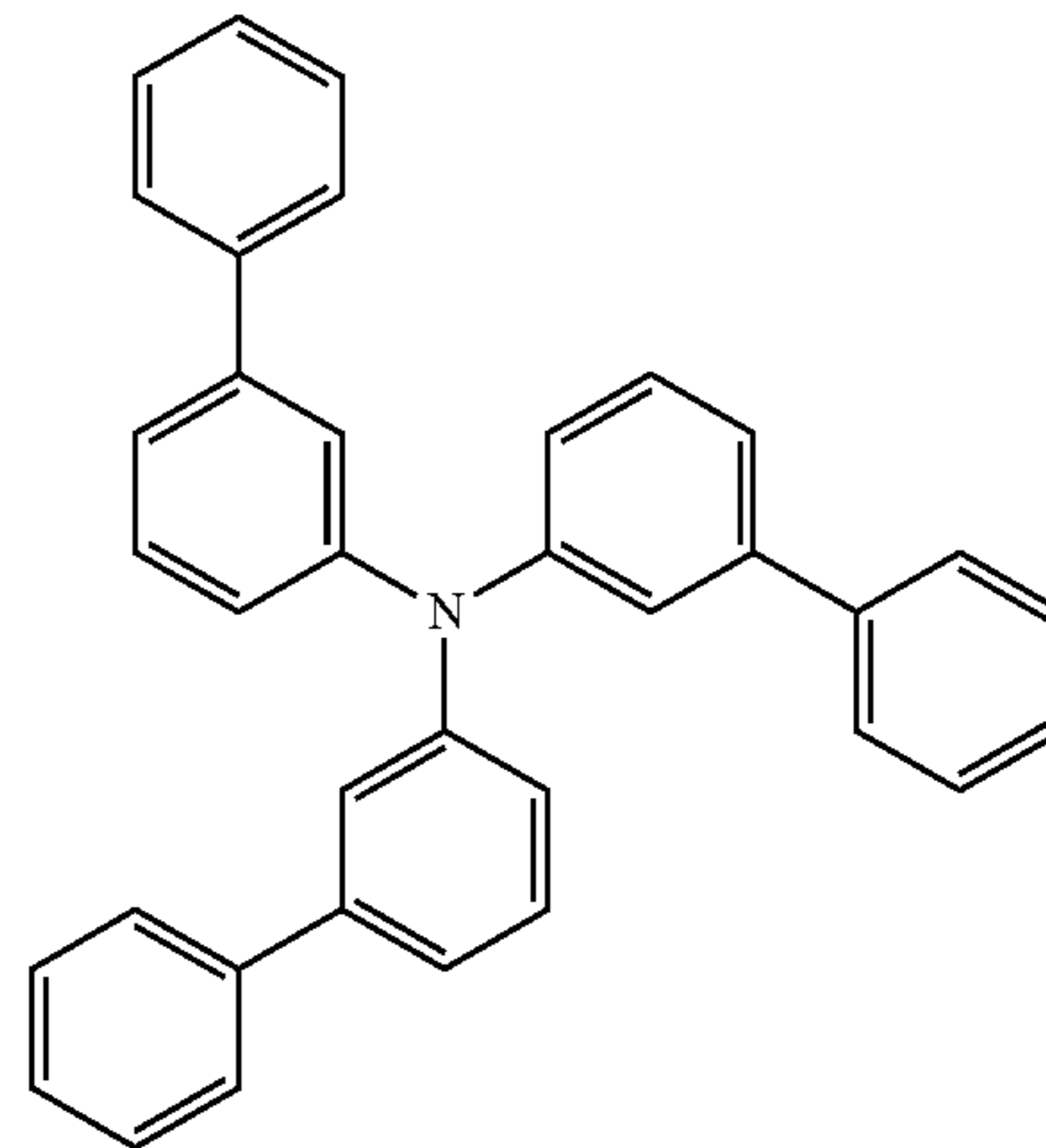
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1-9'

**194**

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1-12'

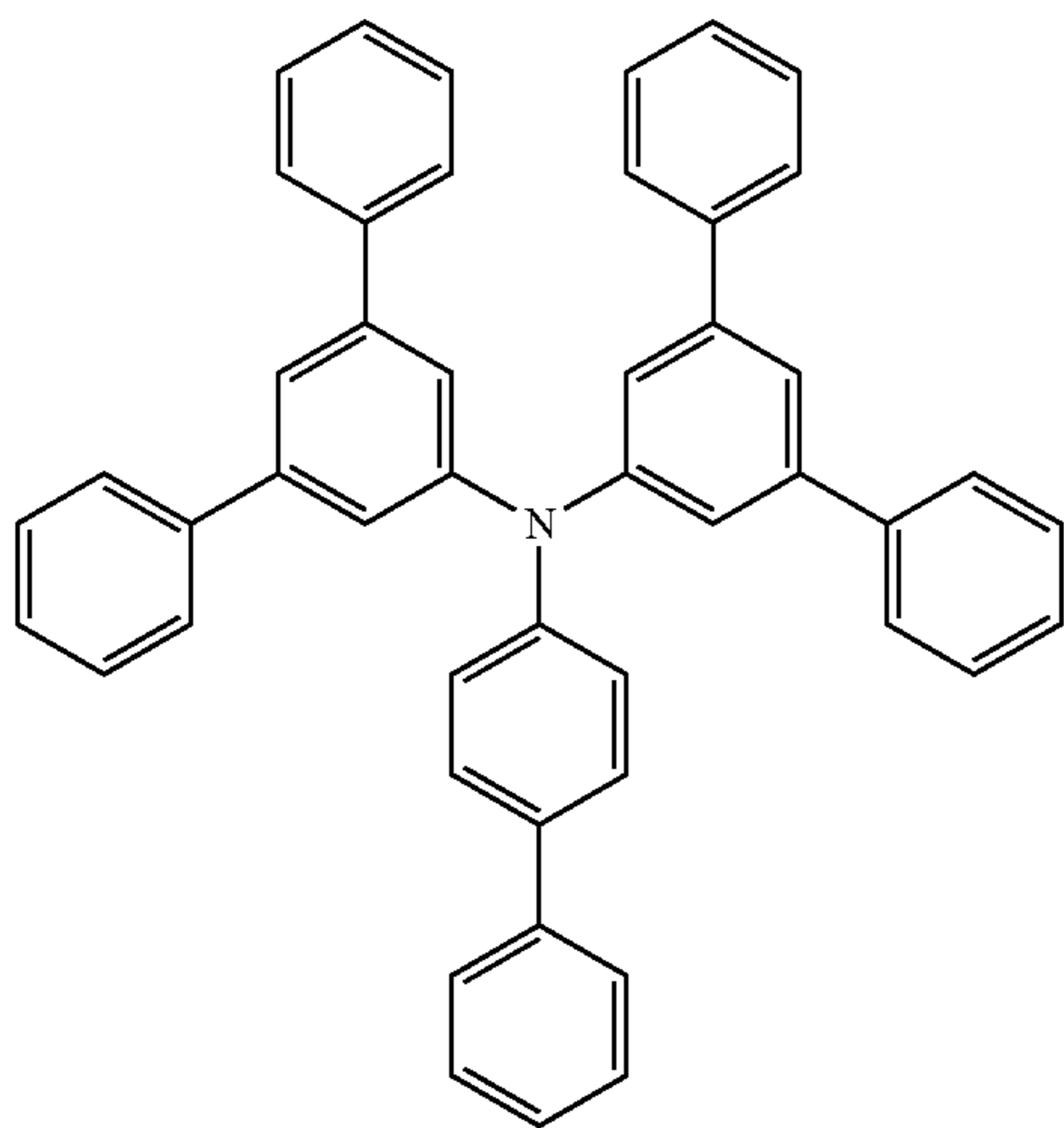
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1-10' 25



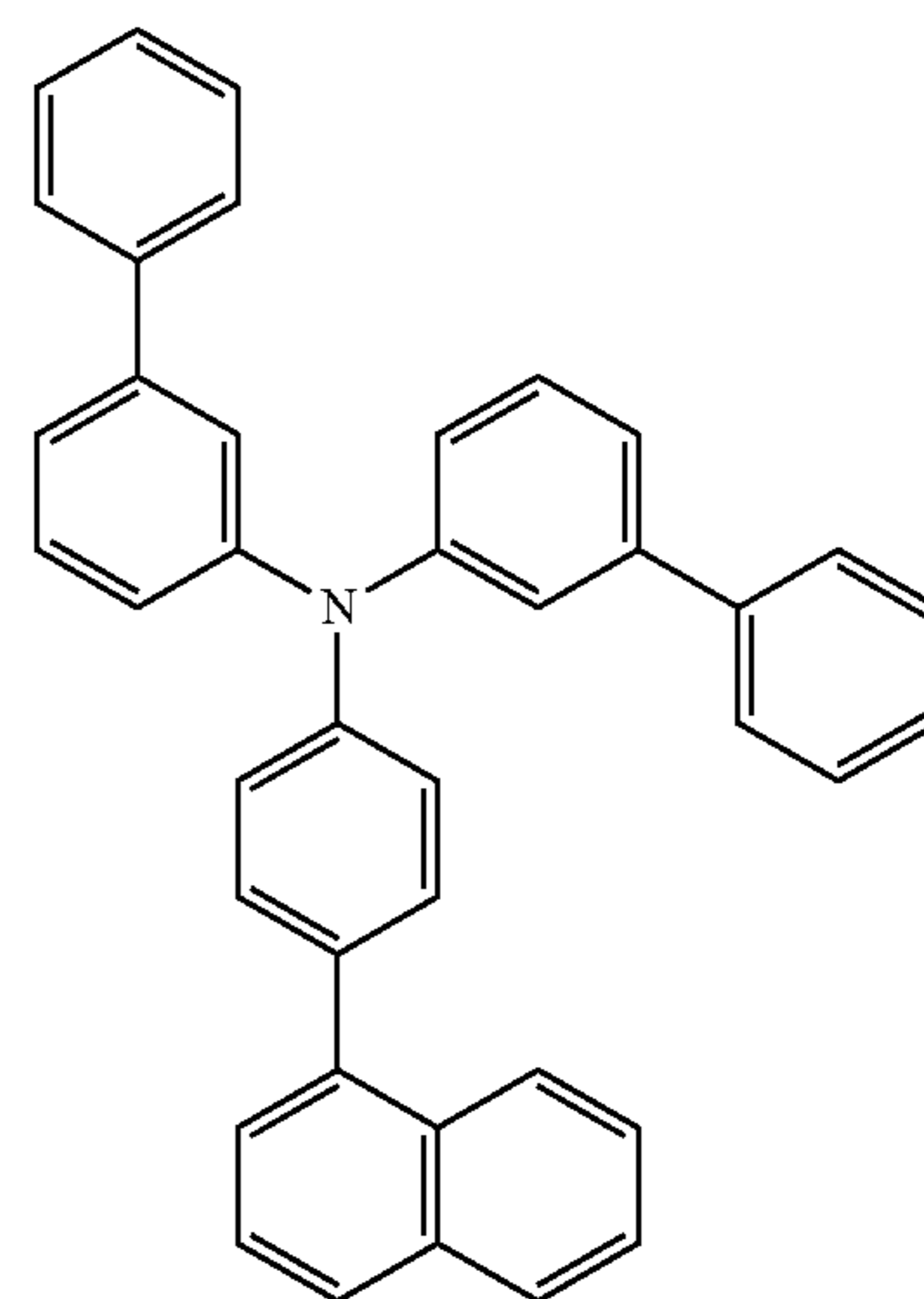
1-13'

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1-11'

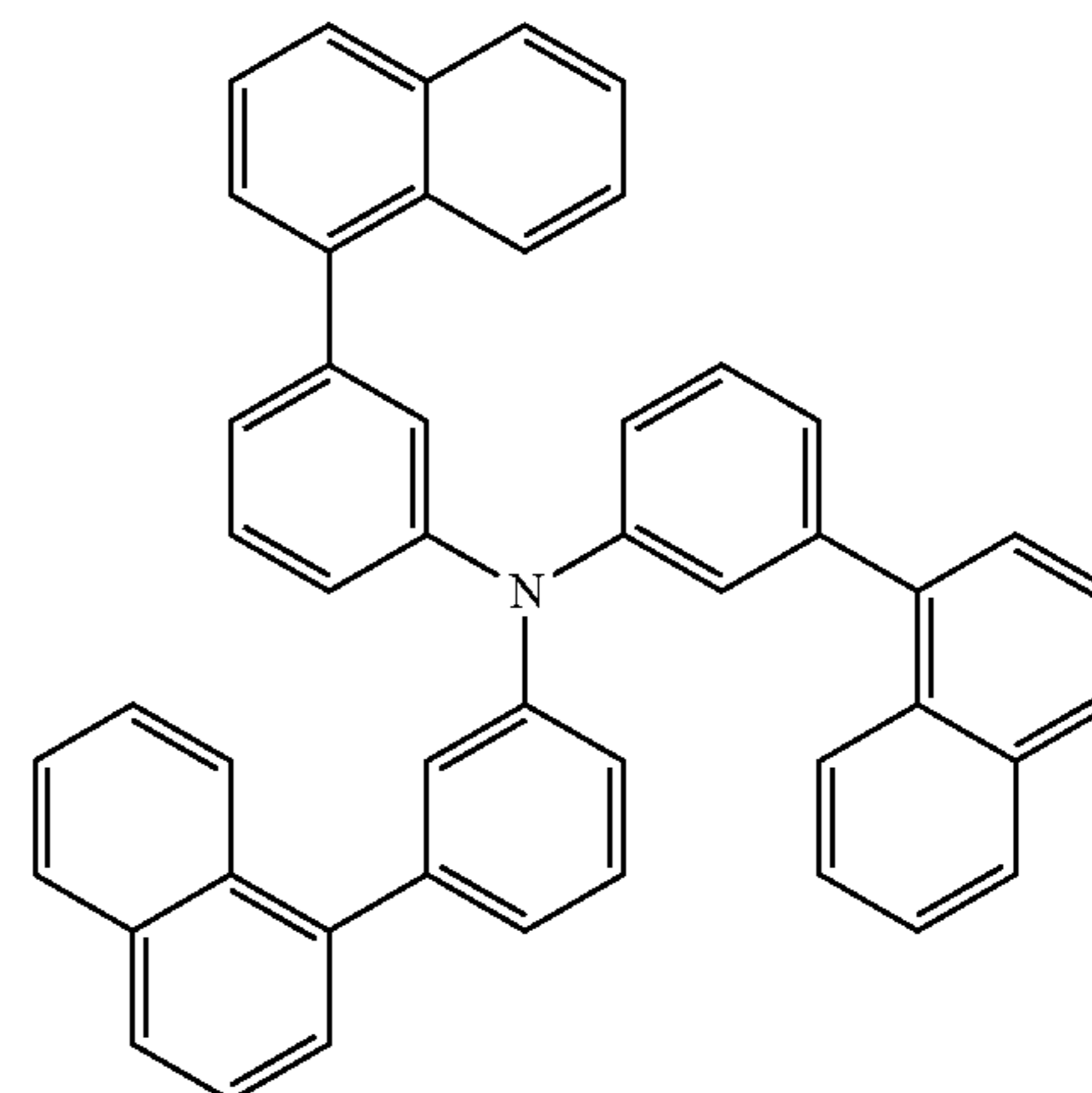
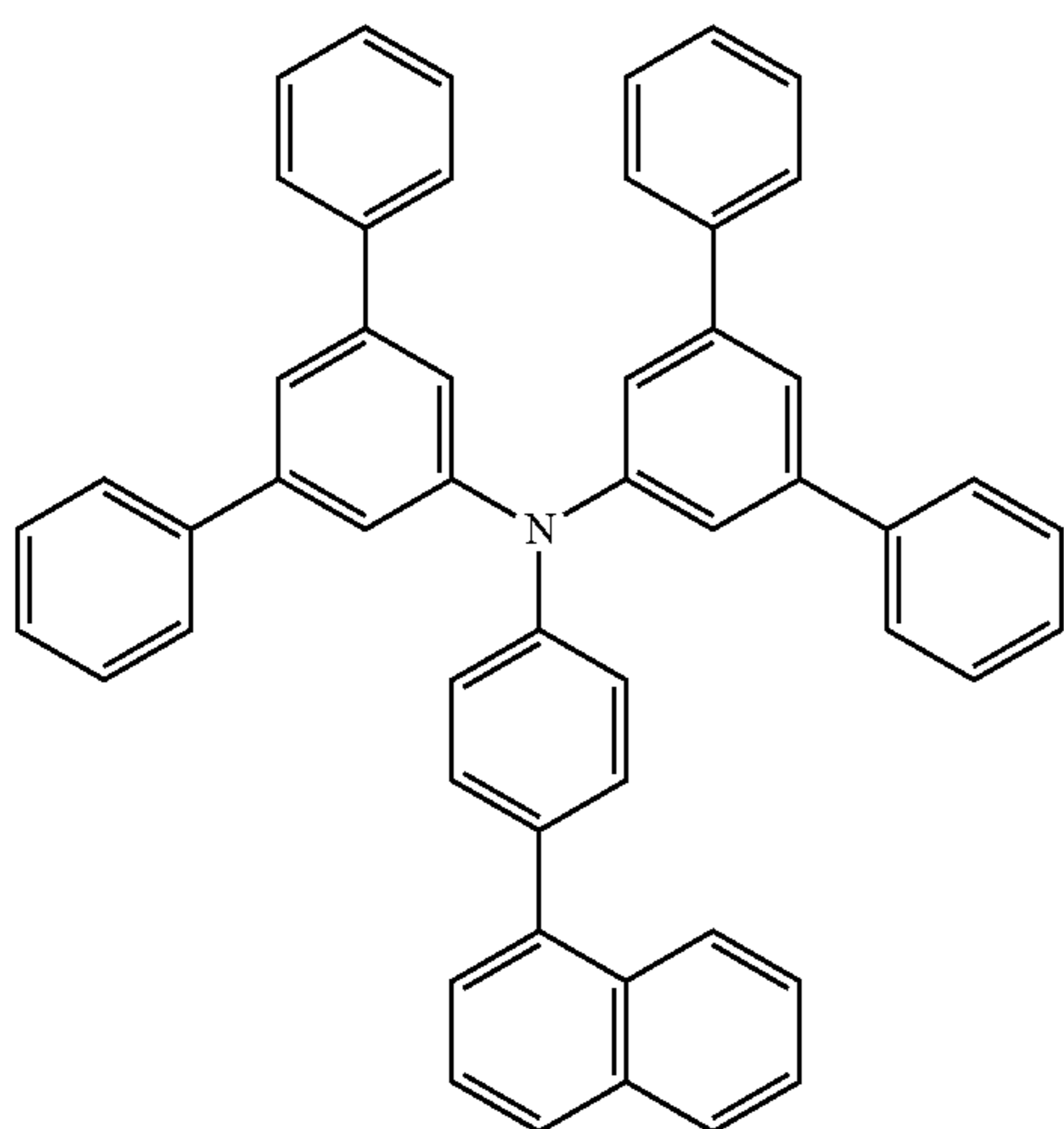
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1-14'

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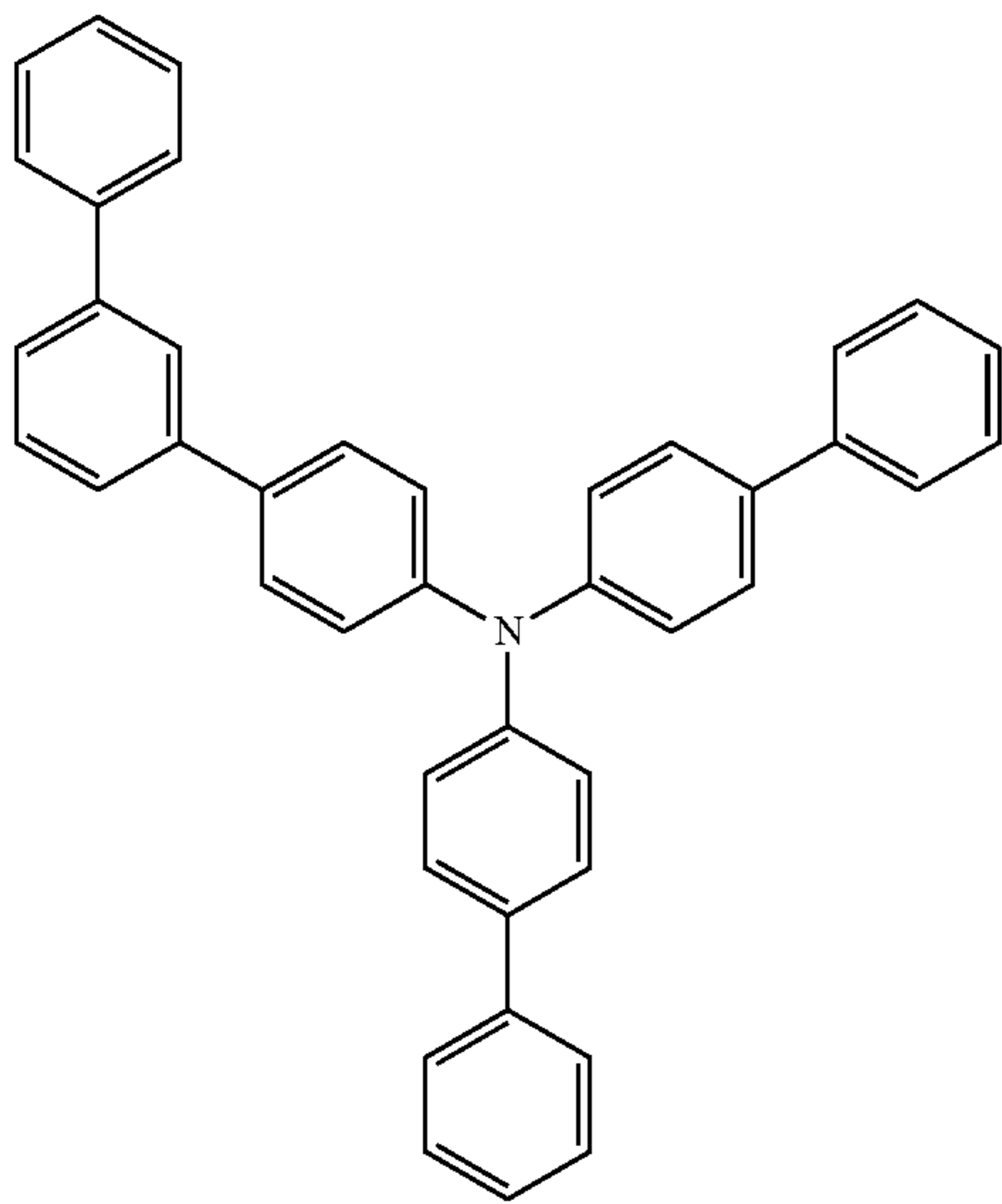
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195

-continued



1-15'

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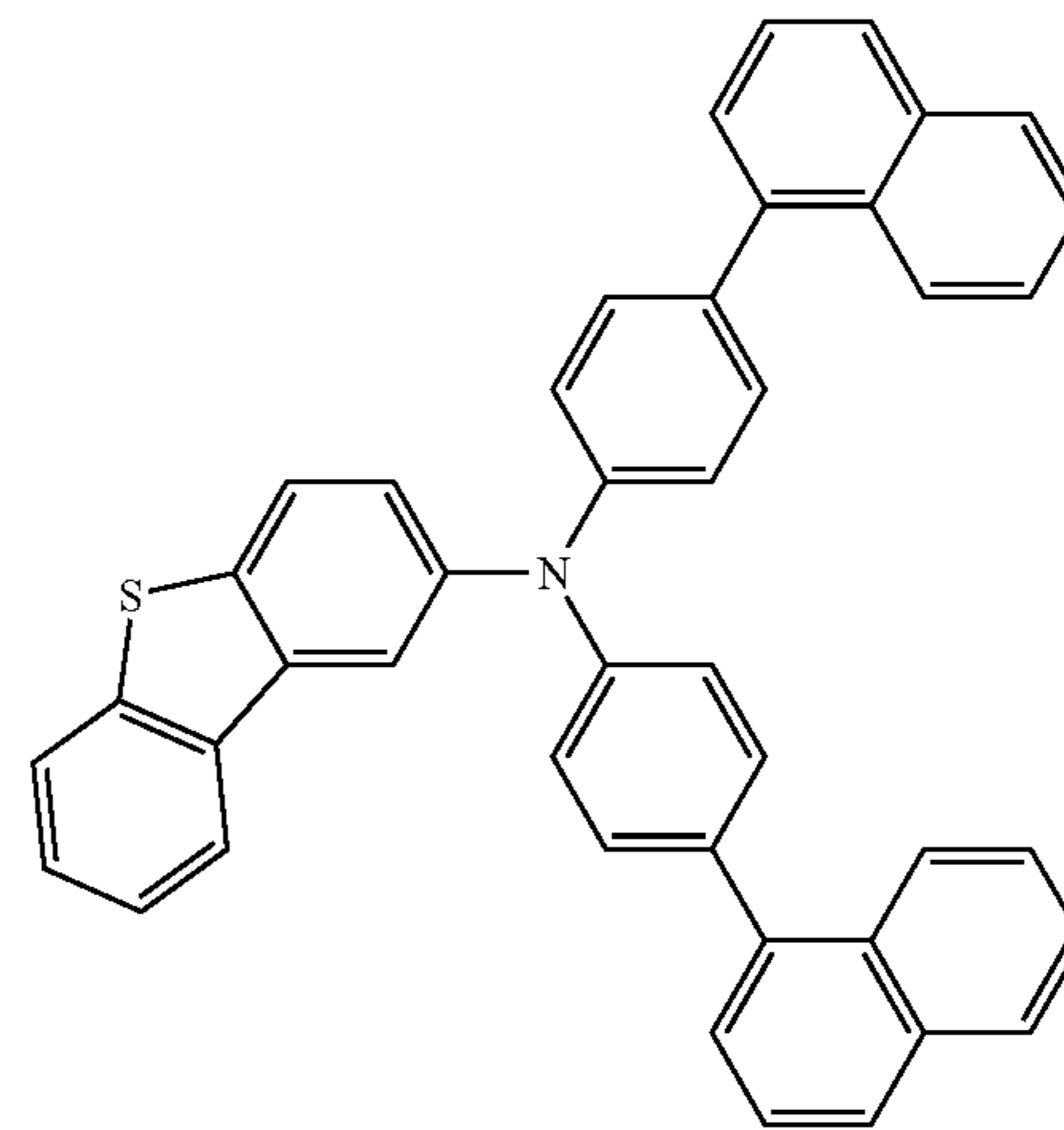
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196

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1-18'

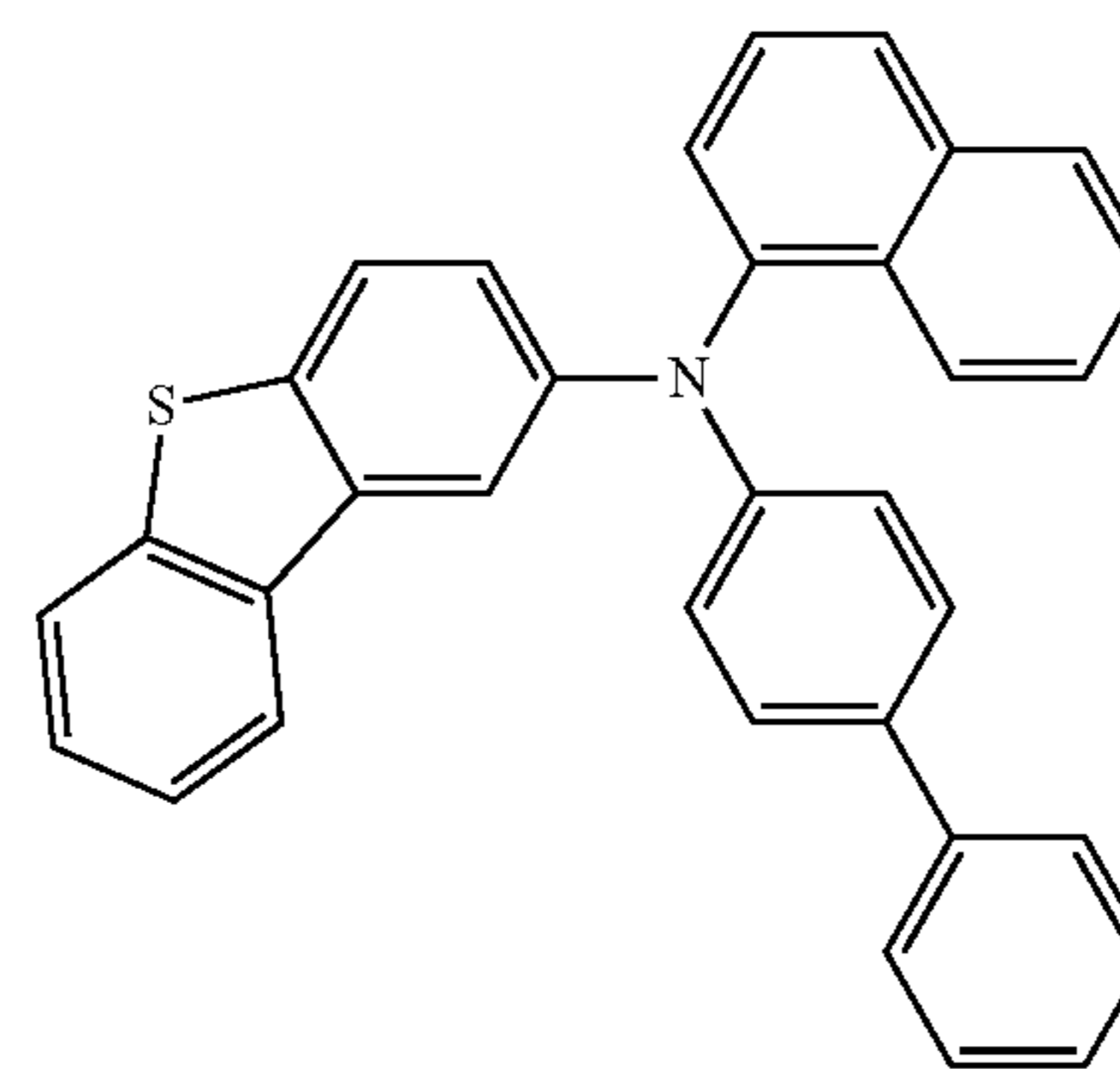
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1-16'

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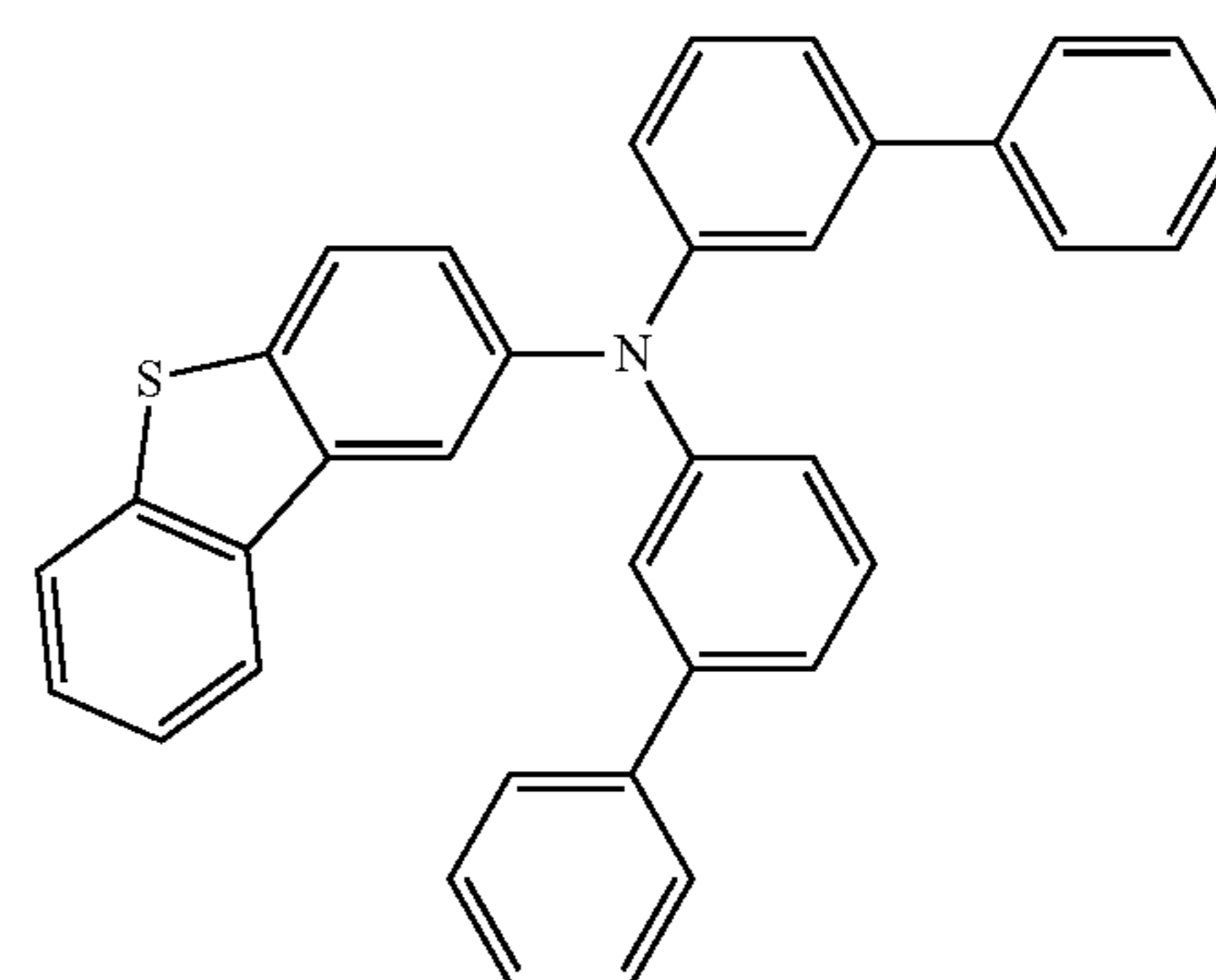
1-19'

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1-17'

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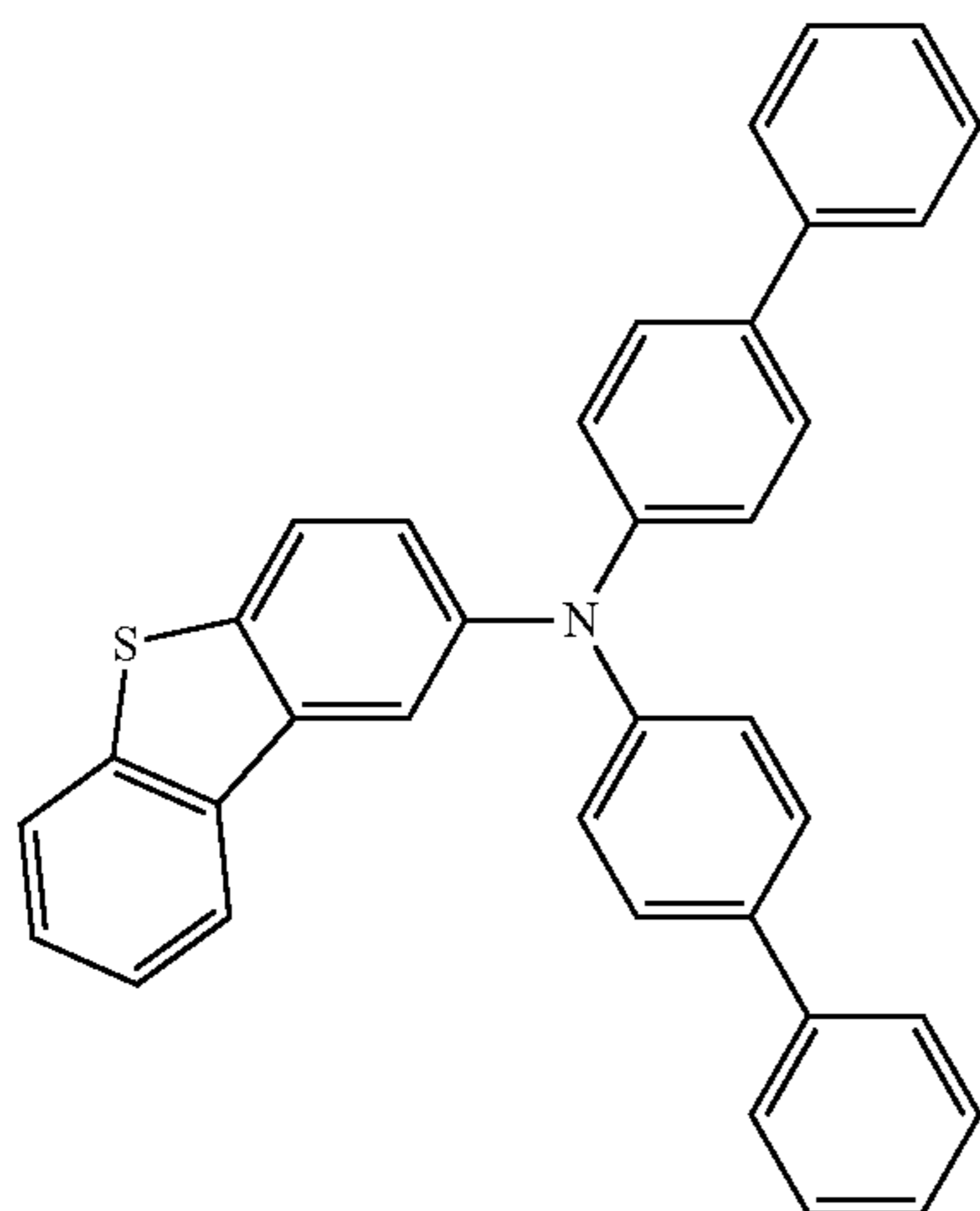
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1-20'

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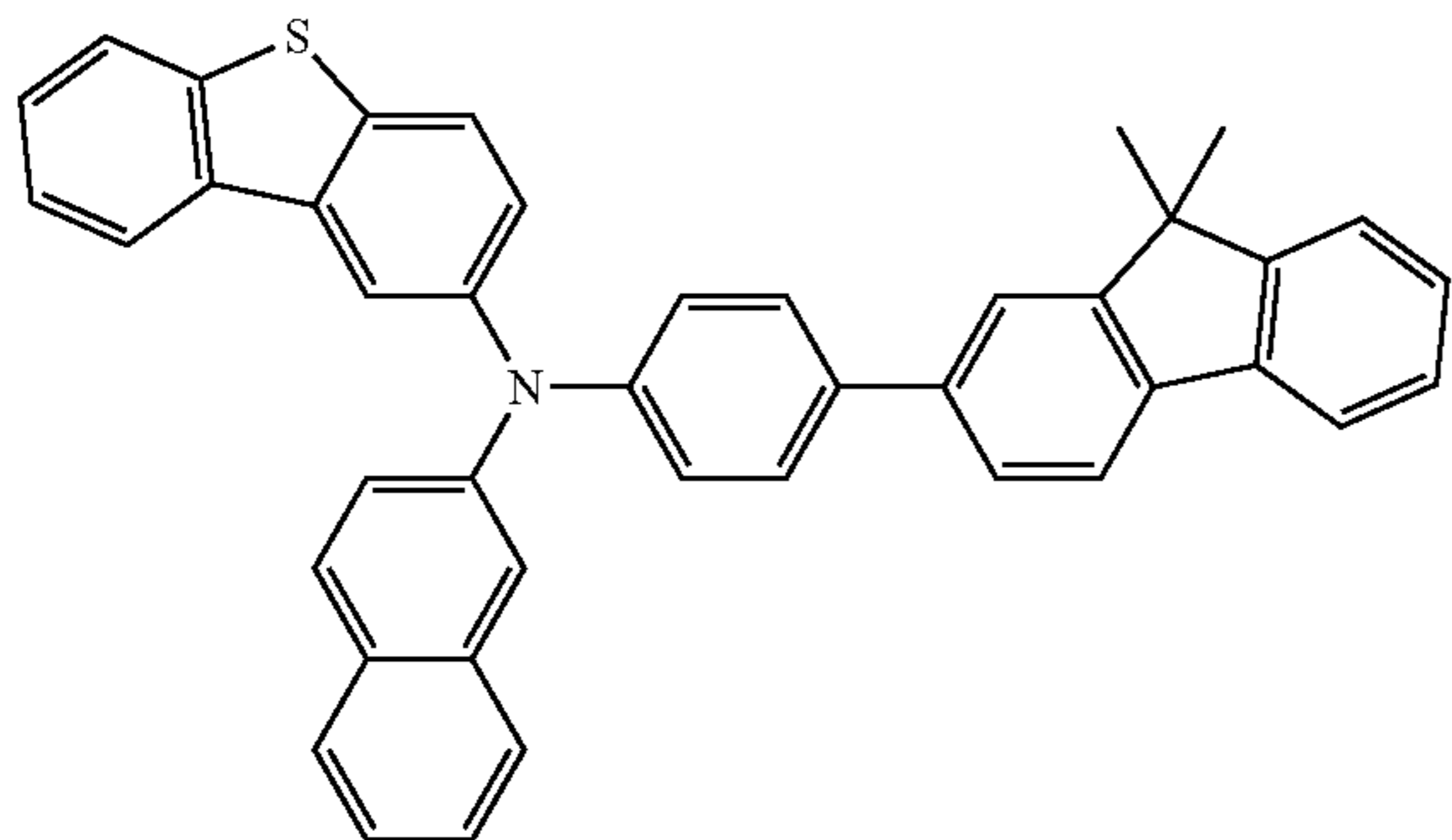


1-21'

197

-continued

1-22'

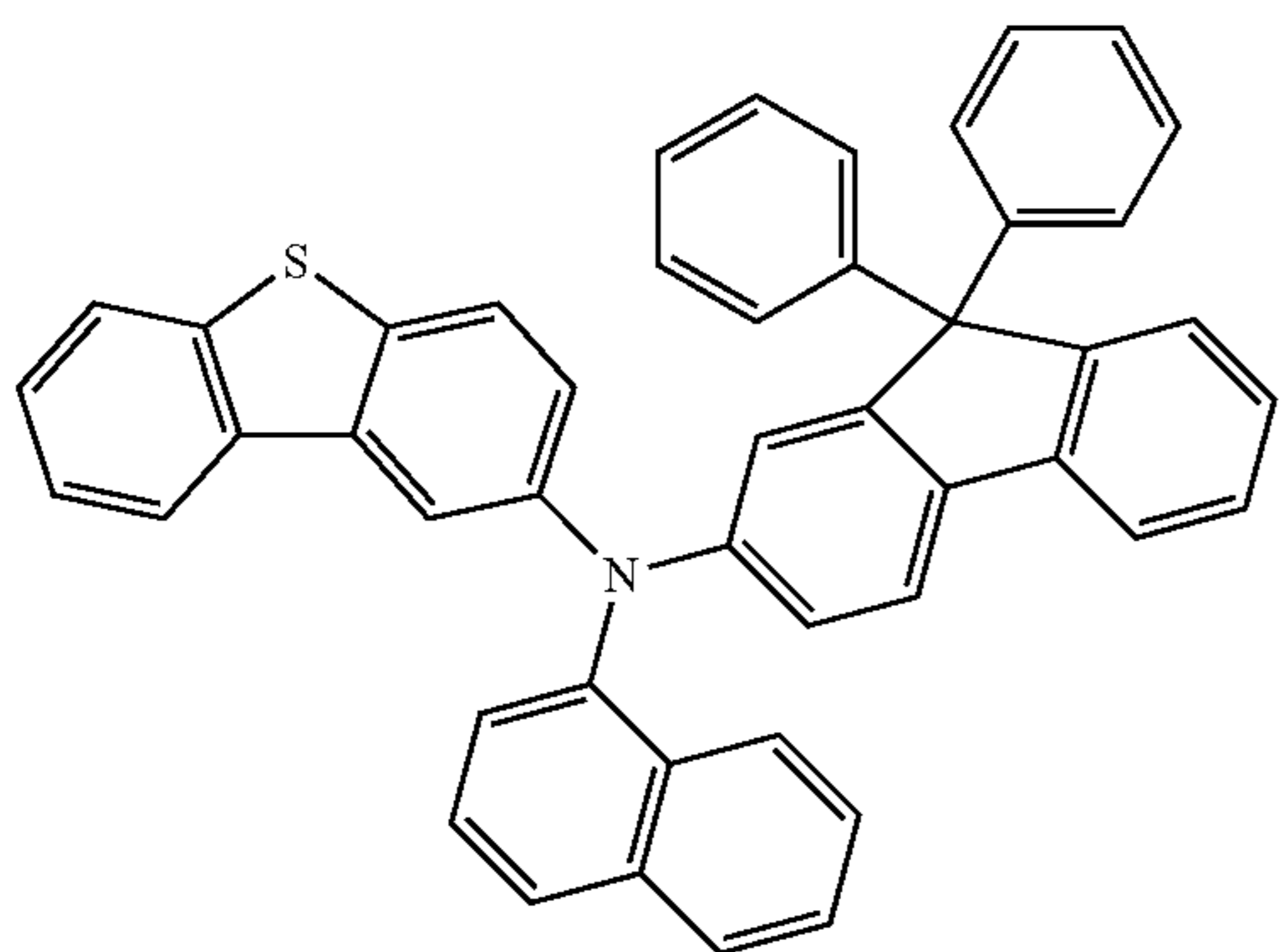


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1-23'

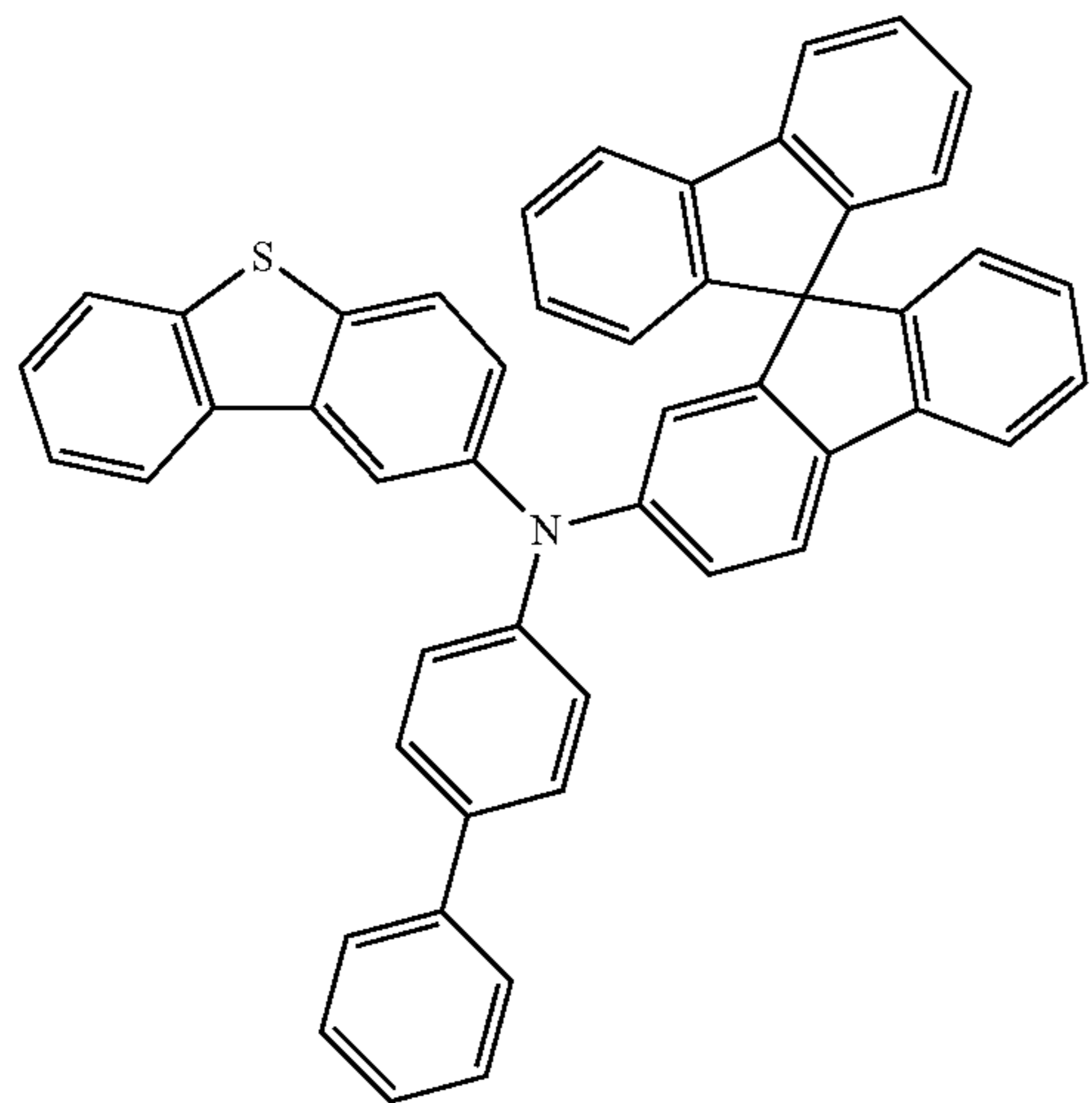


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1-24'



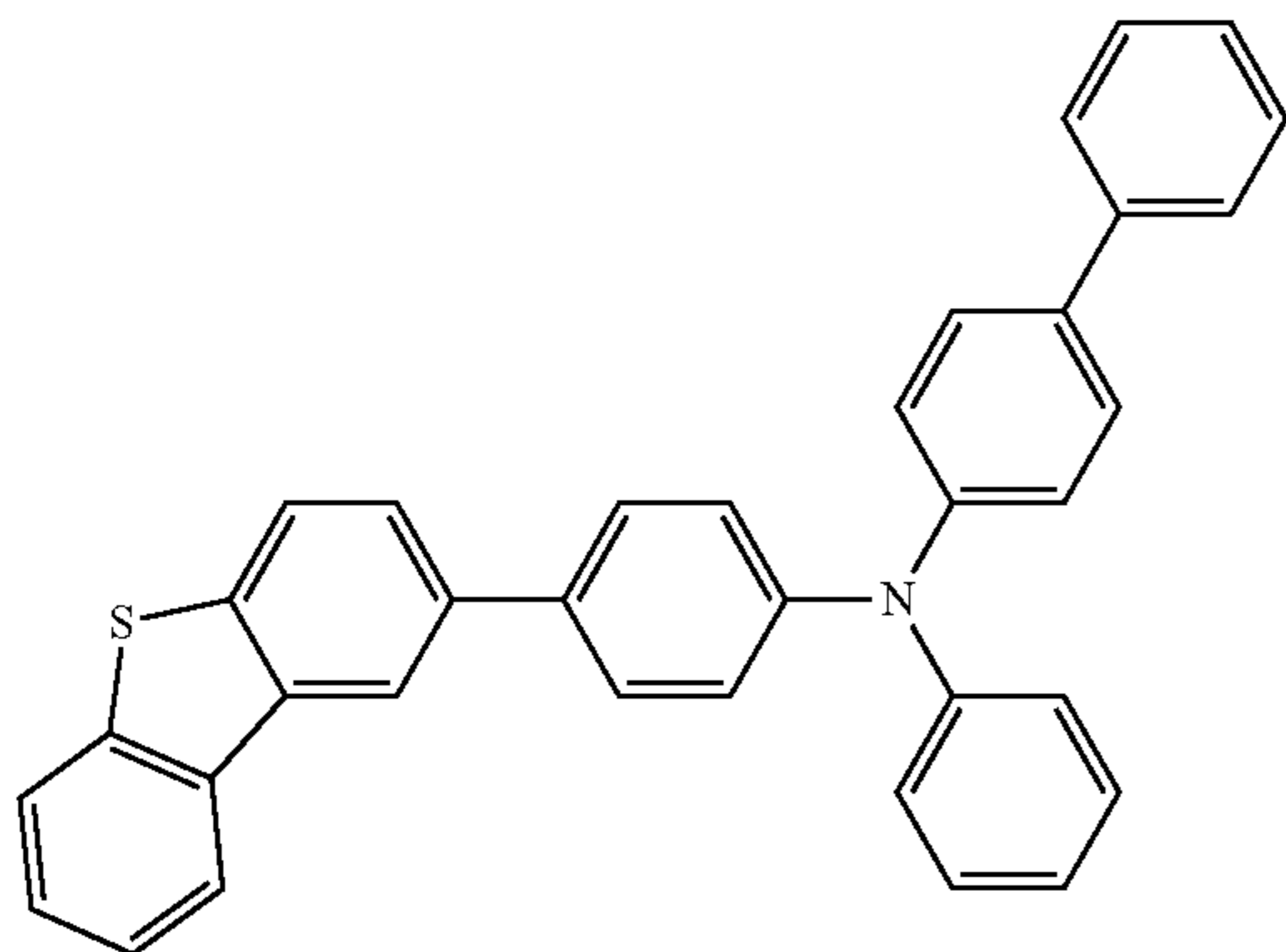
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1-25'



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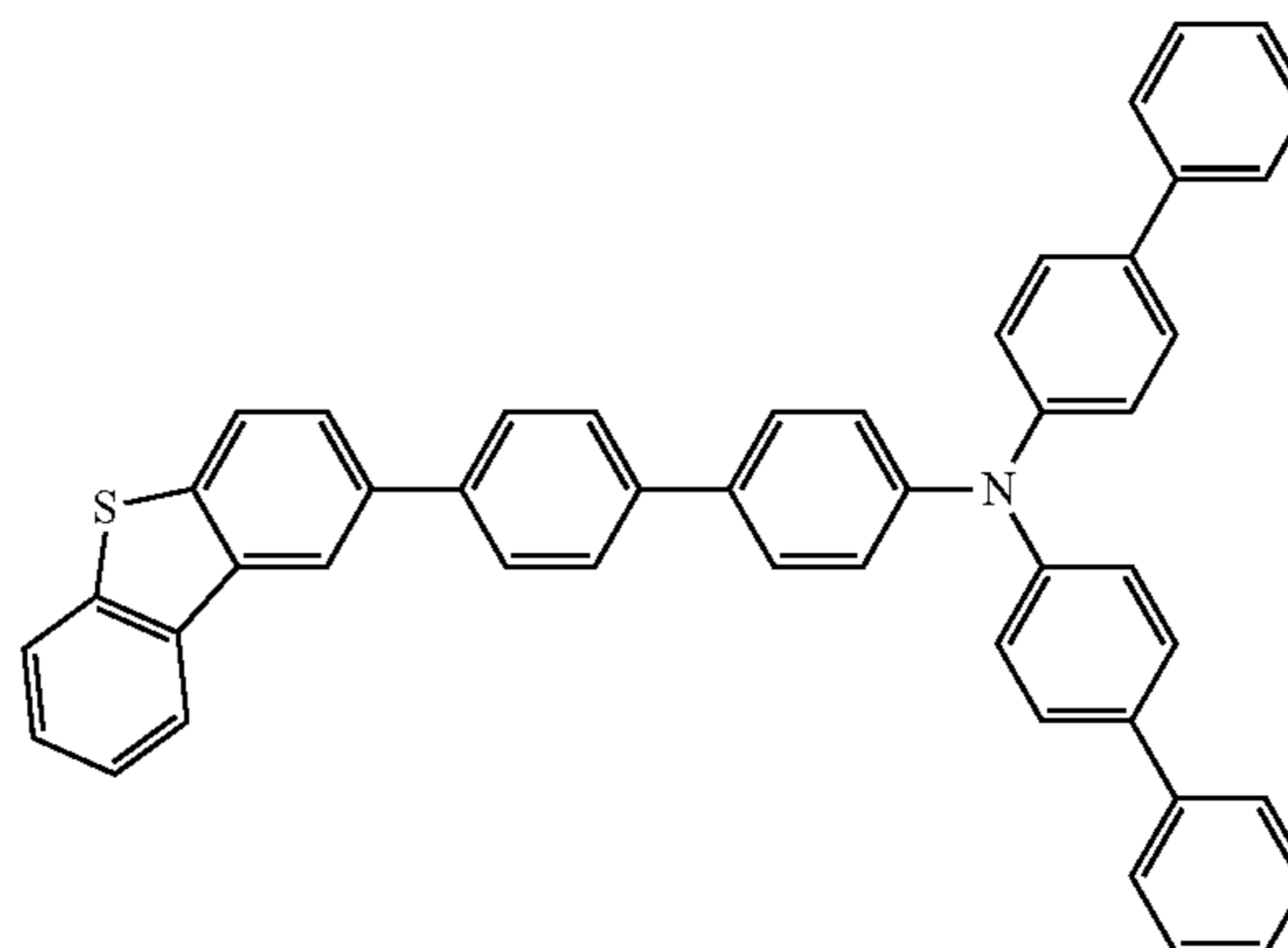
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198

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1-26'

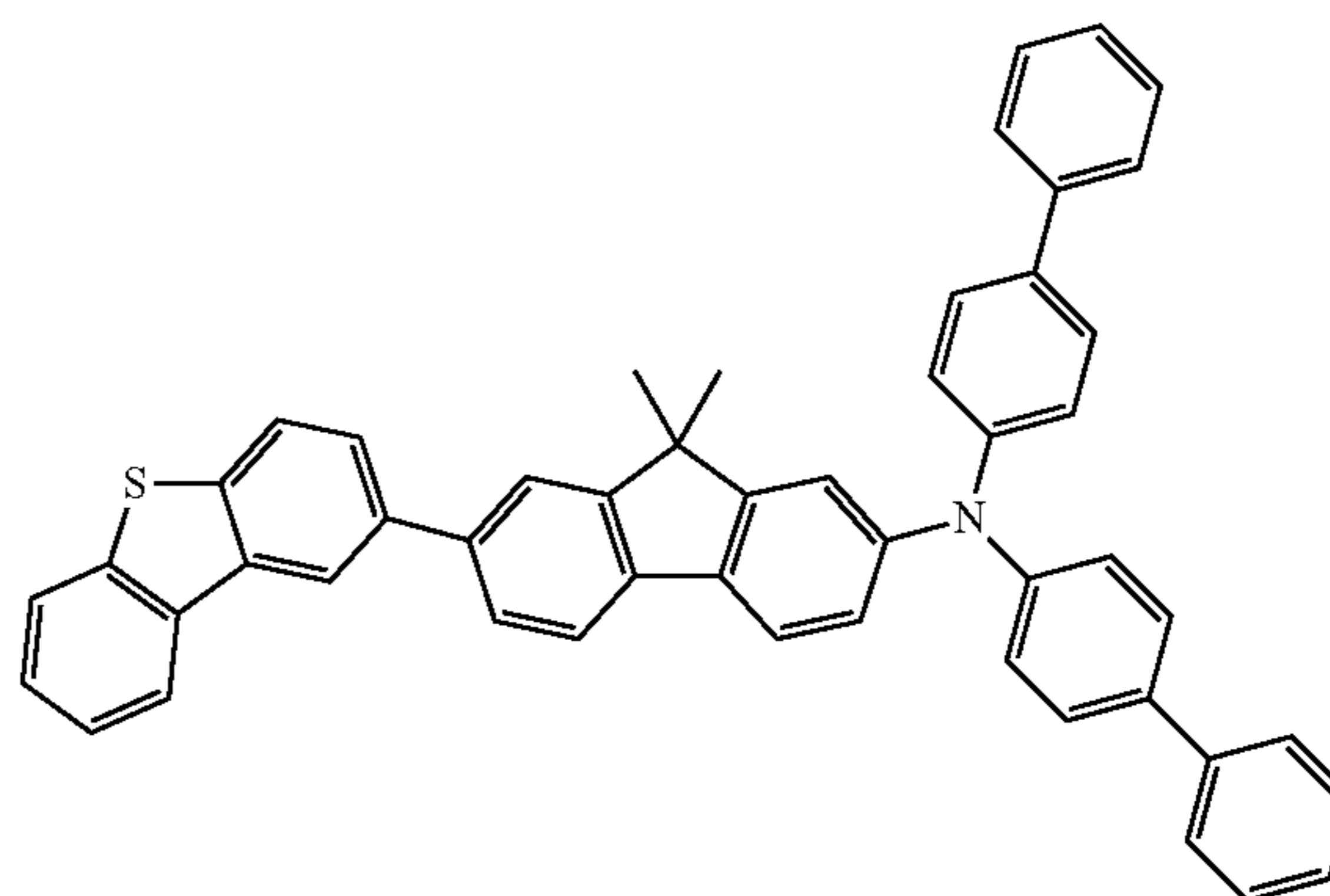


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1-27'



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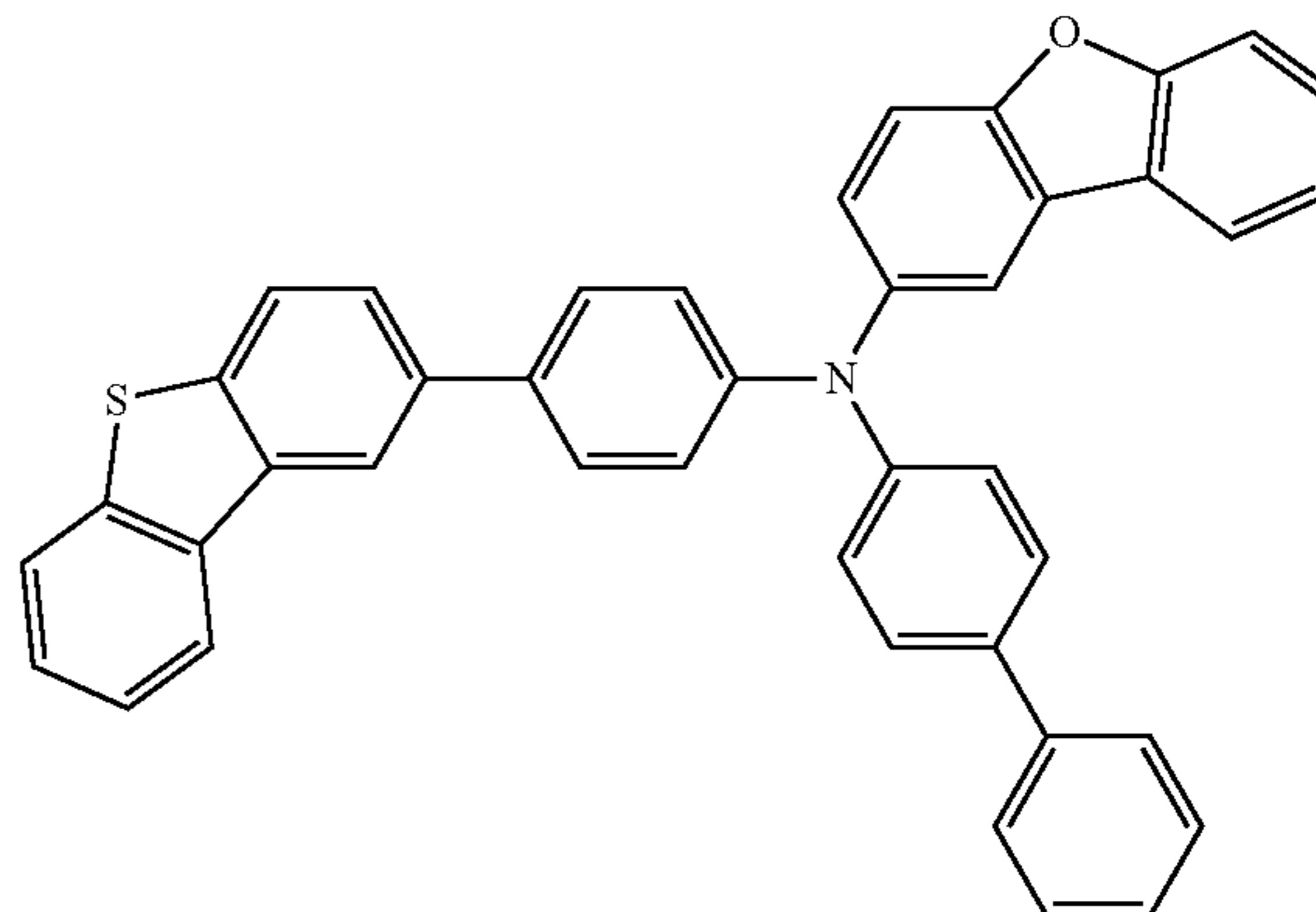
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1-28'

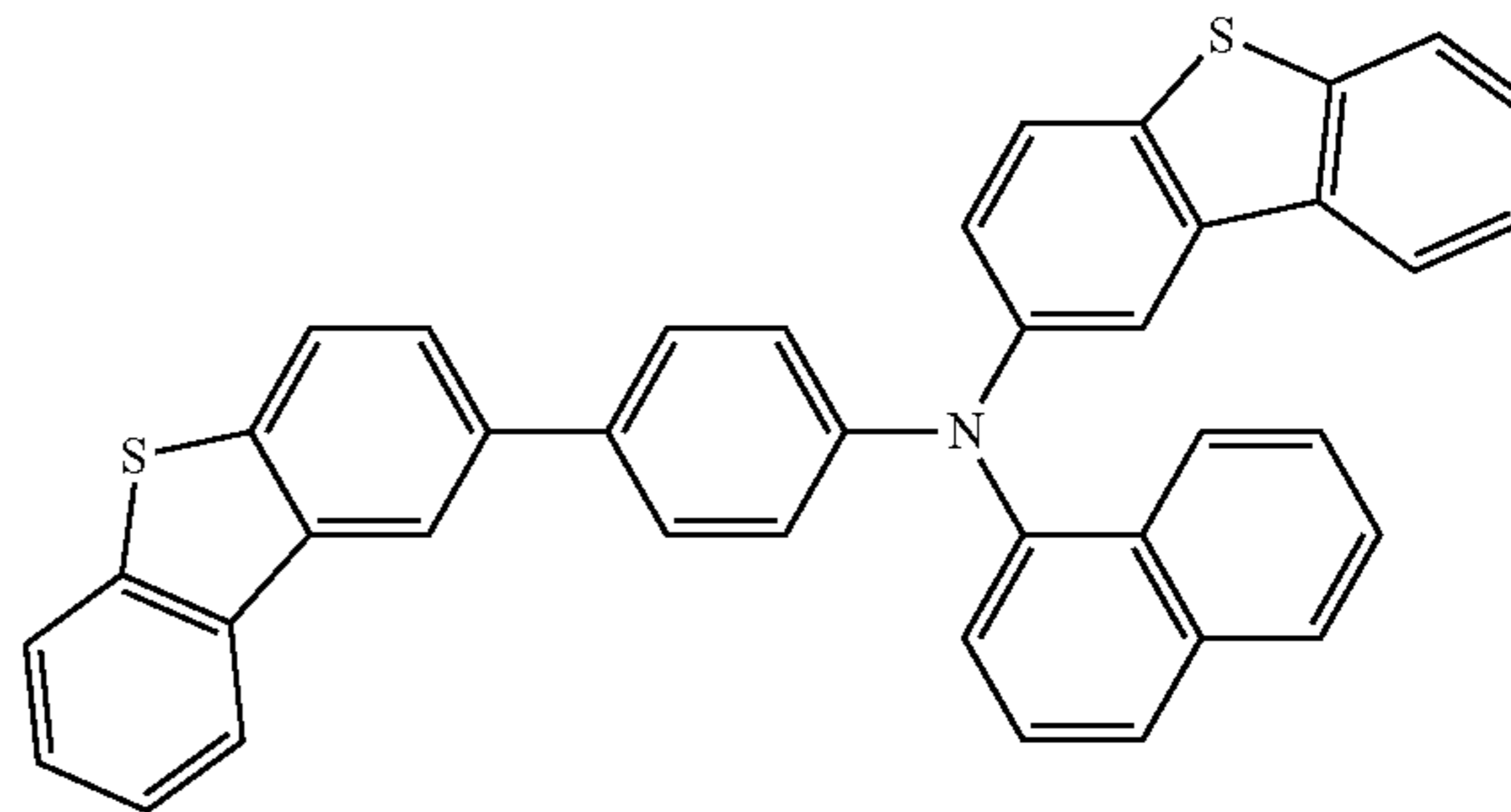


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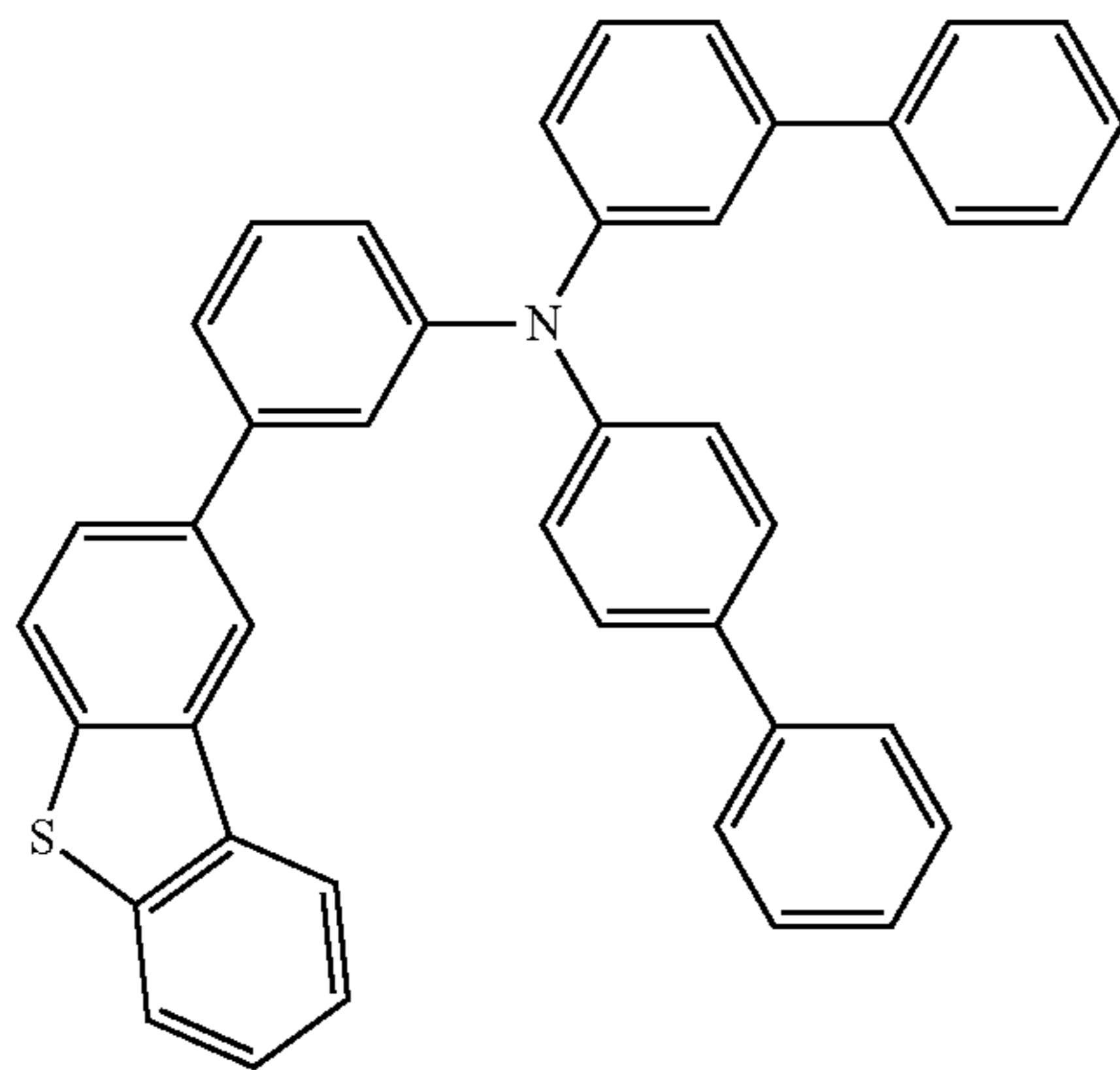
65

1-29'



**199**

-continued



1-30'

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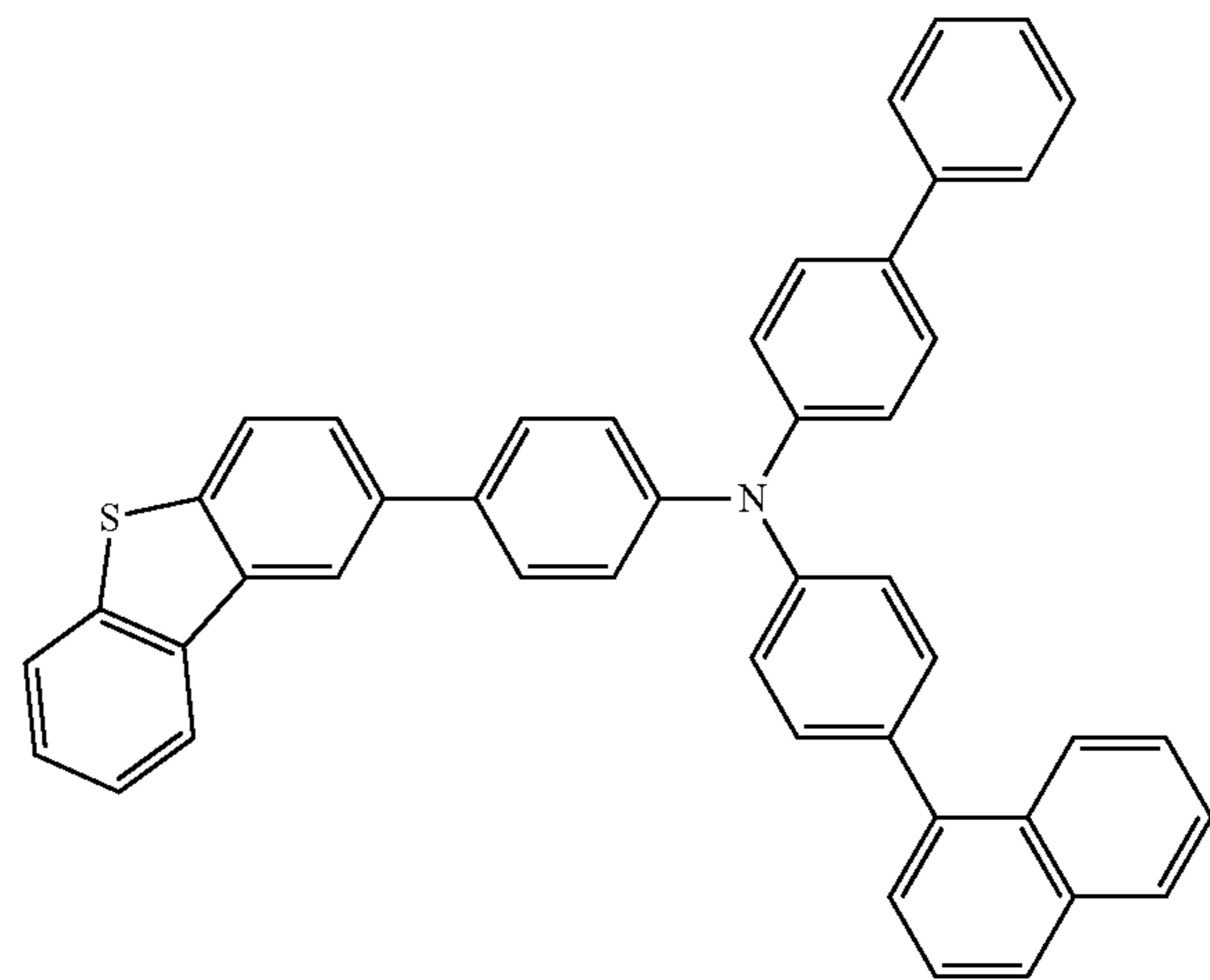
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**200**

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1-33'

1-31'

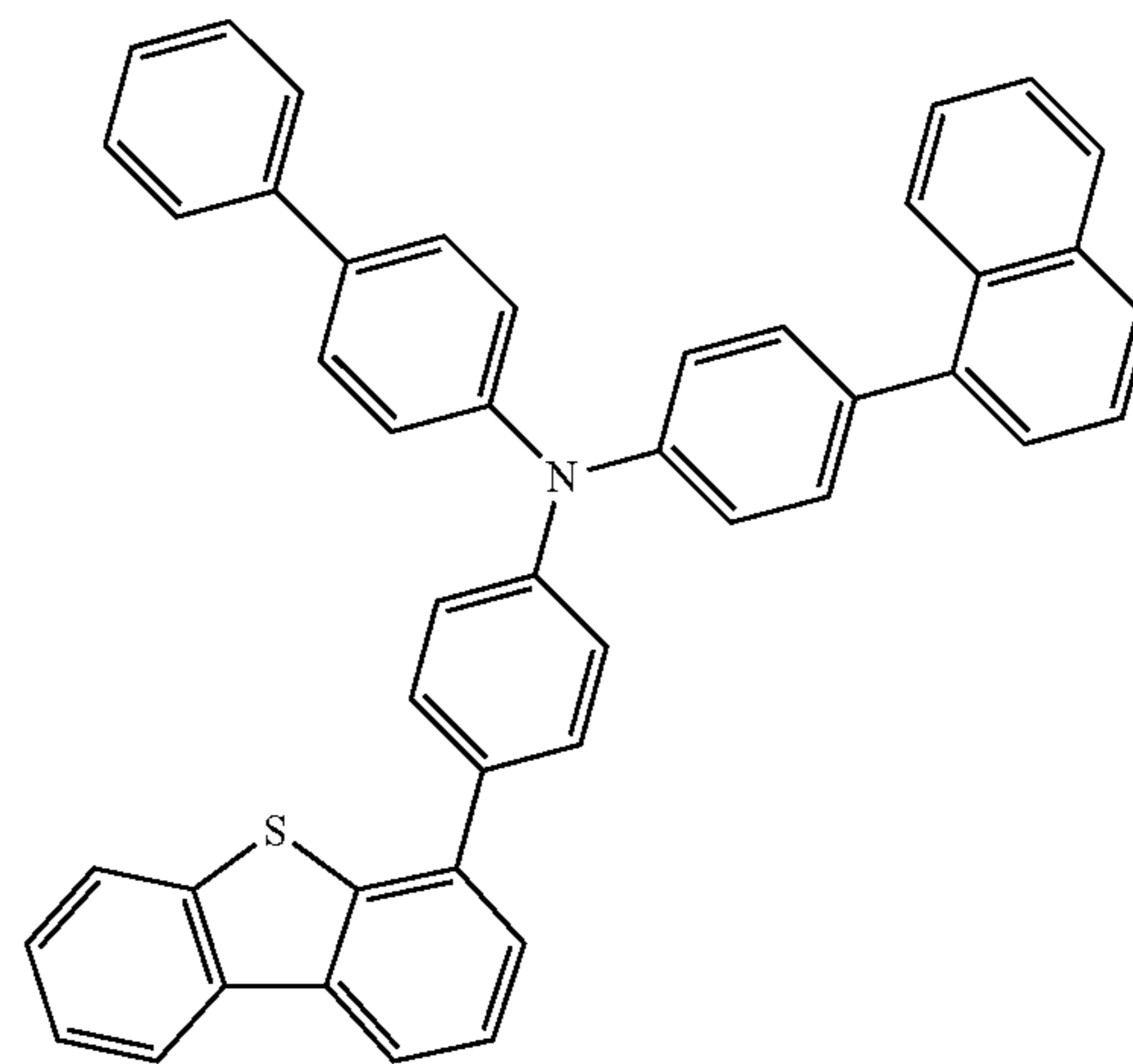
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1-34'

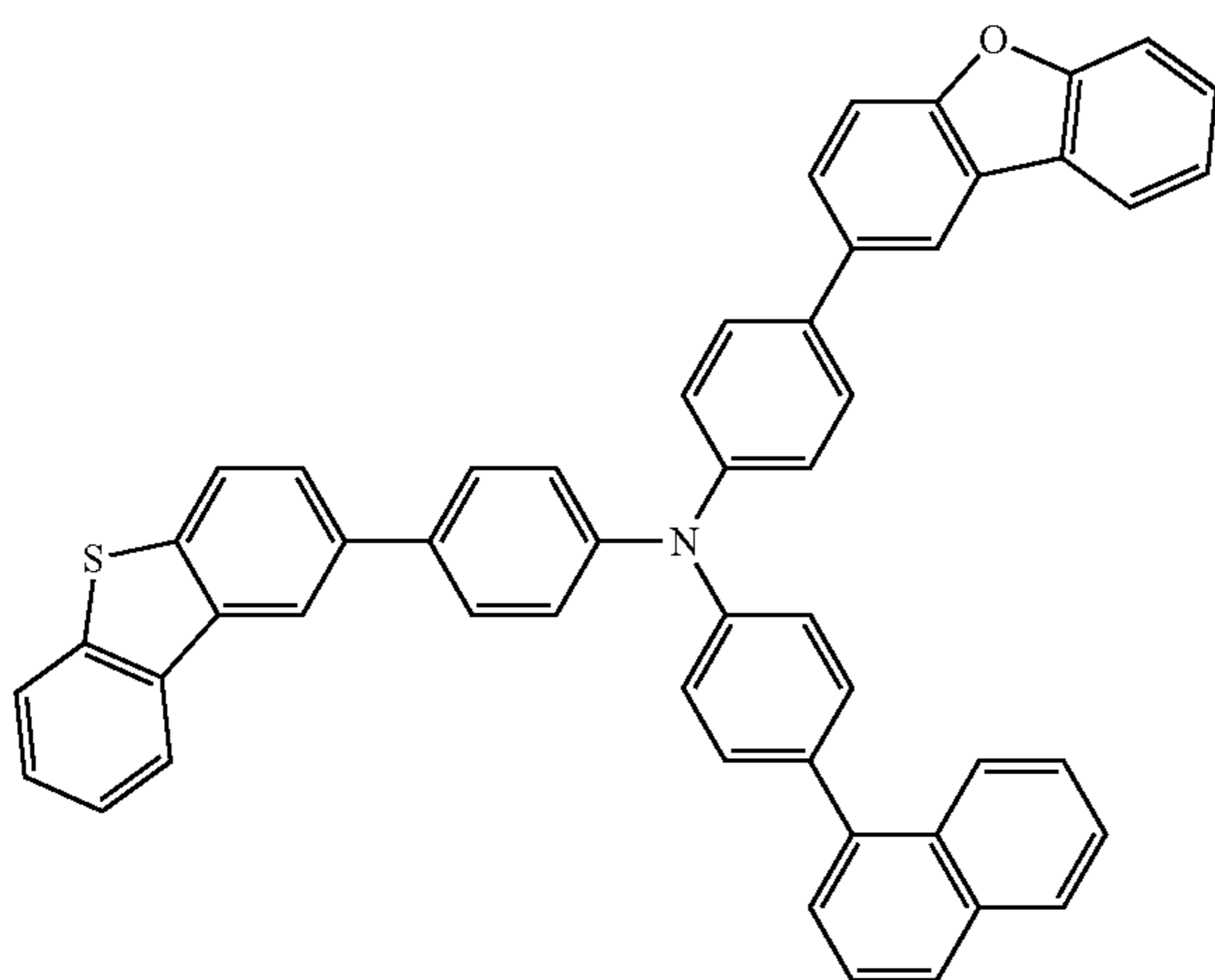
1-32'

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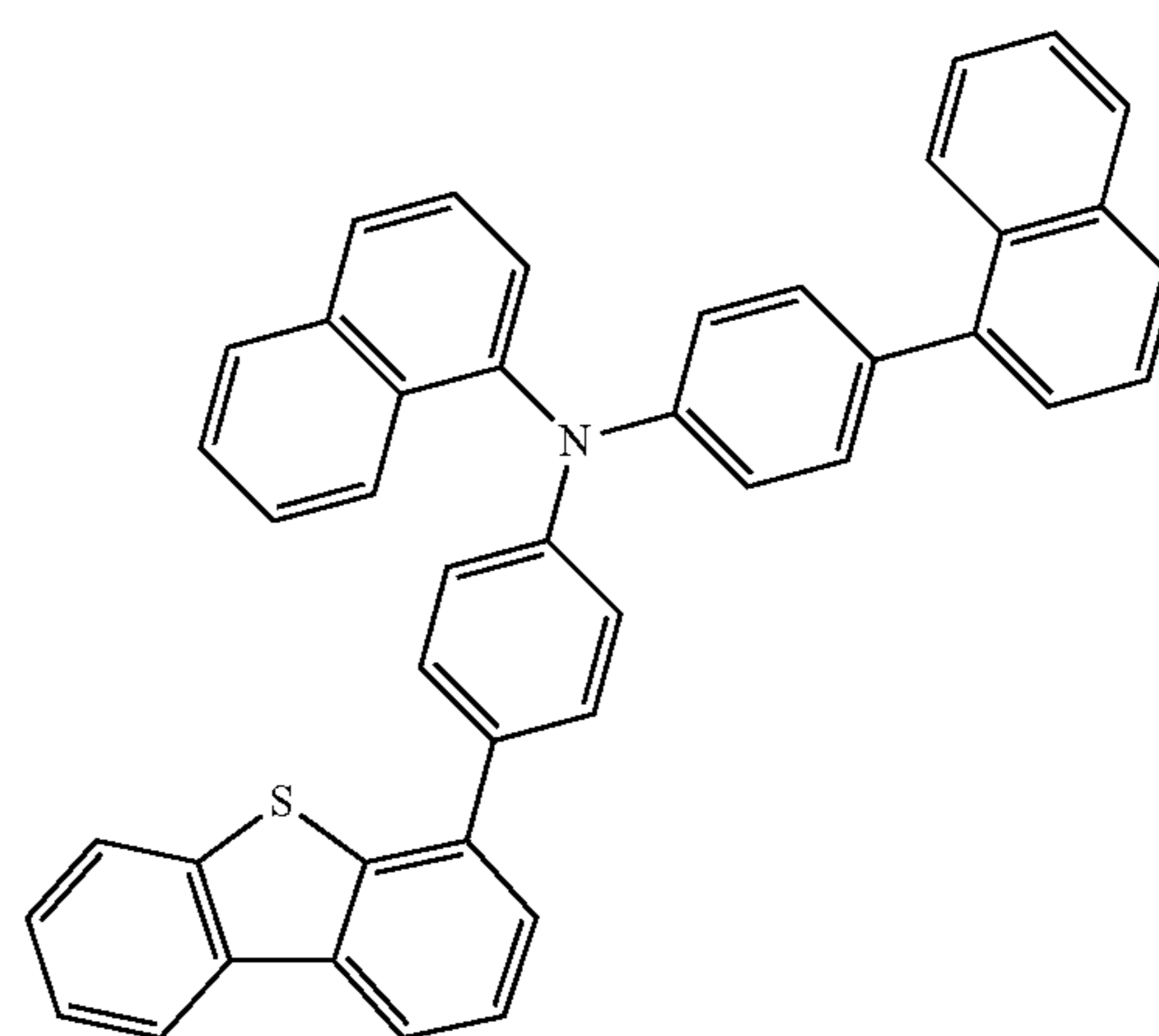
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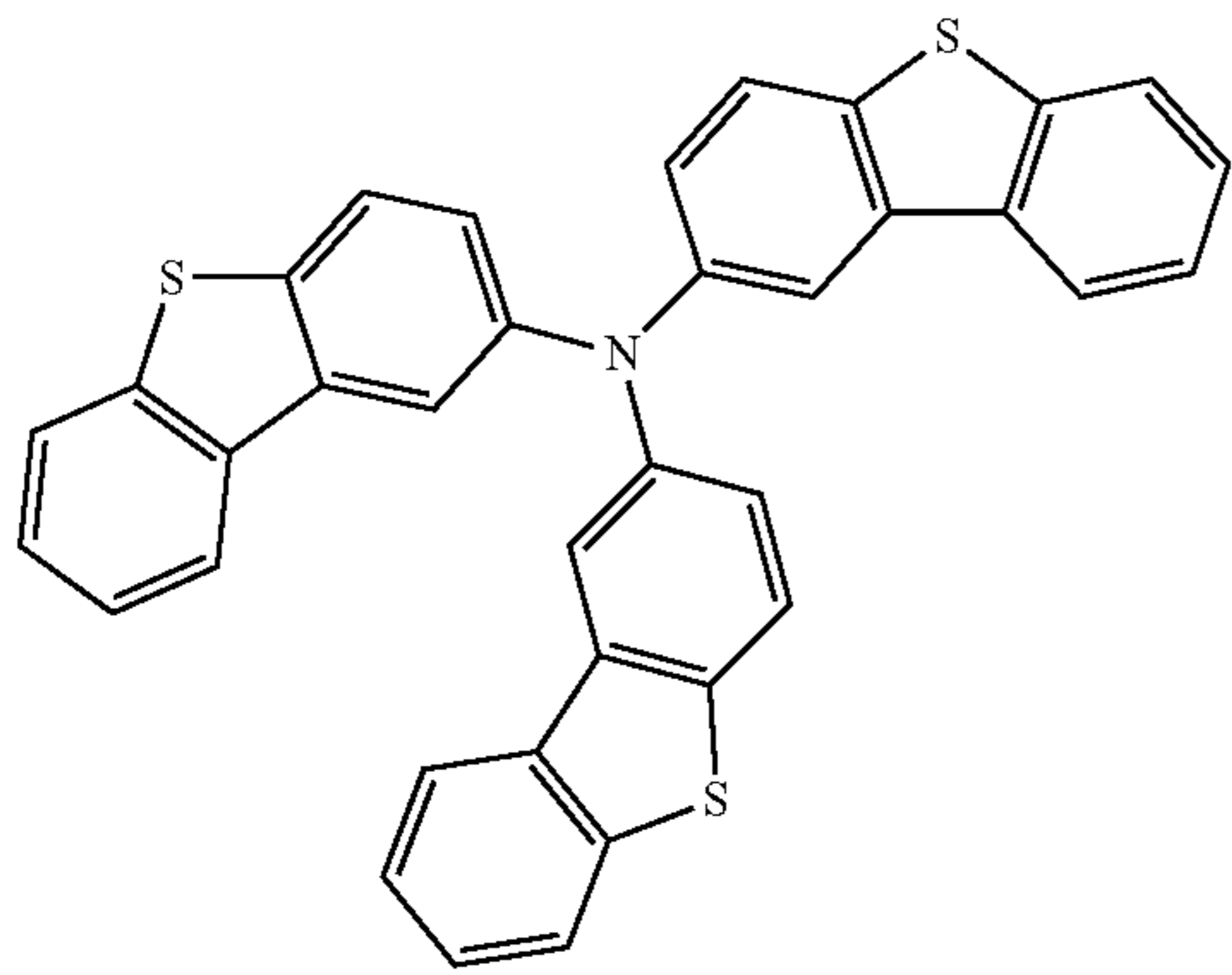
1-35'



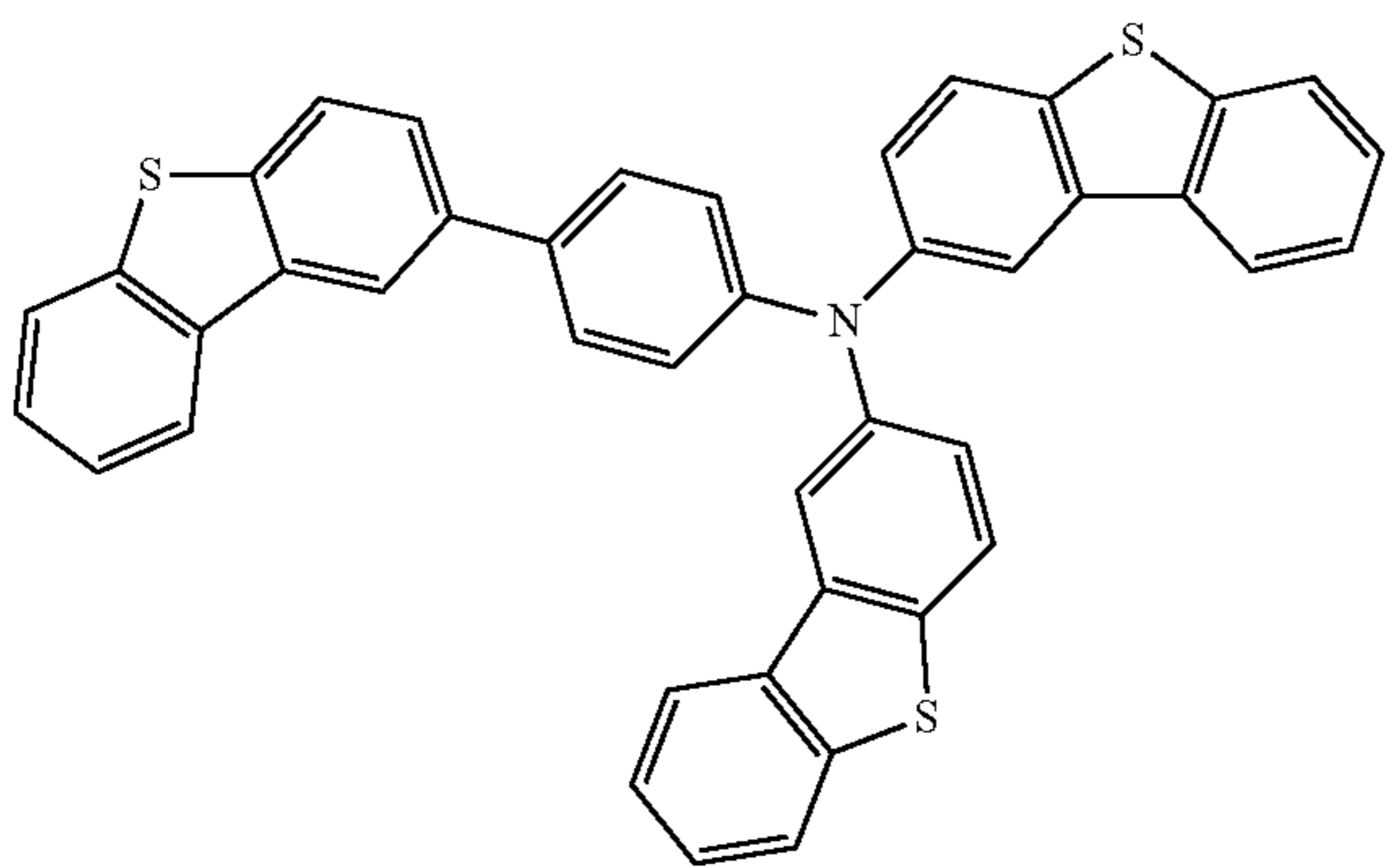
201

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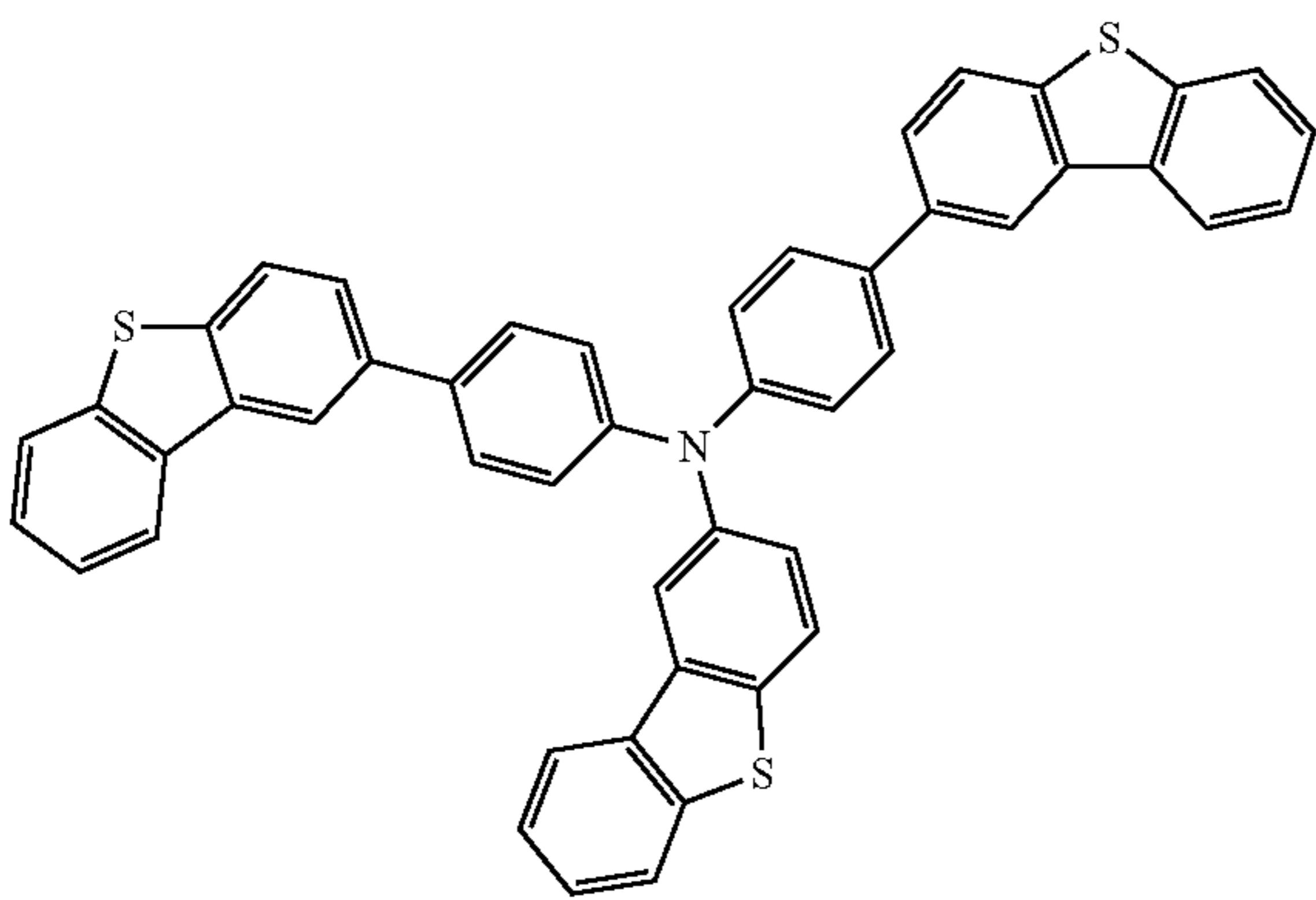
1-36'



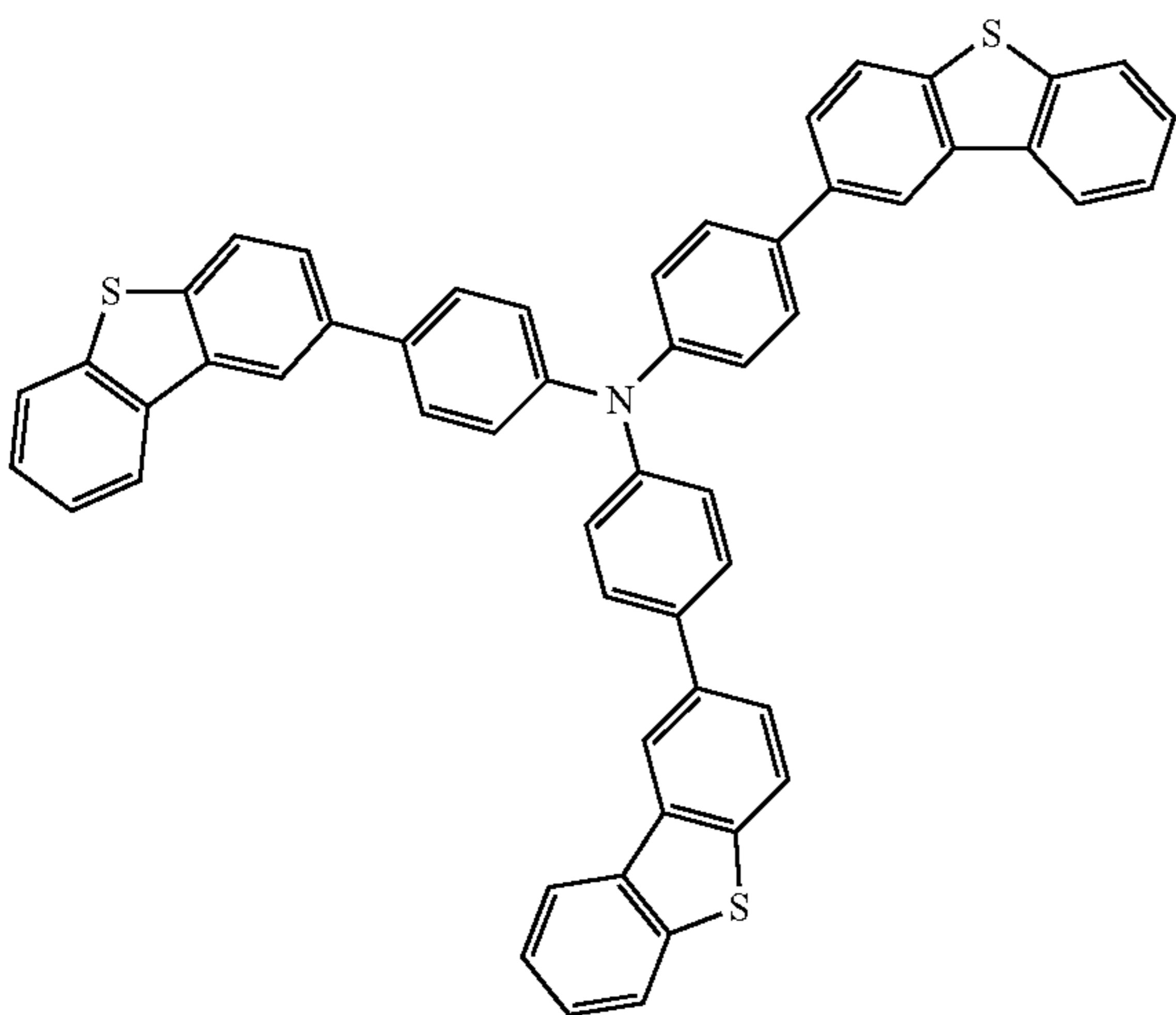
1-37'



1-38'



1-39'

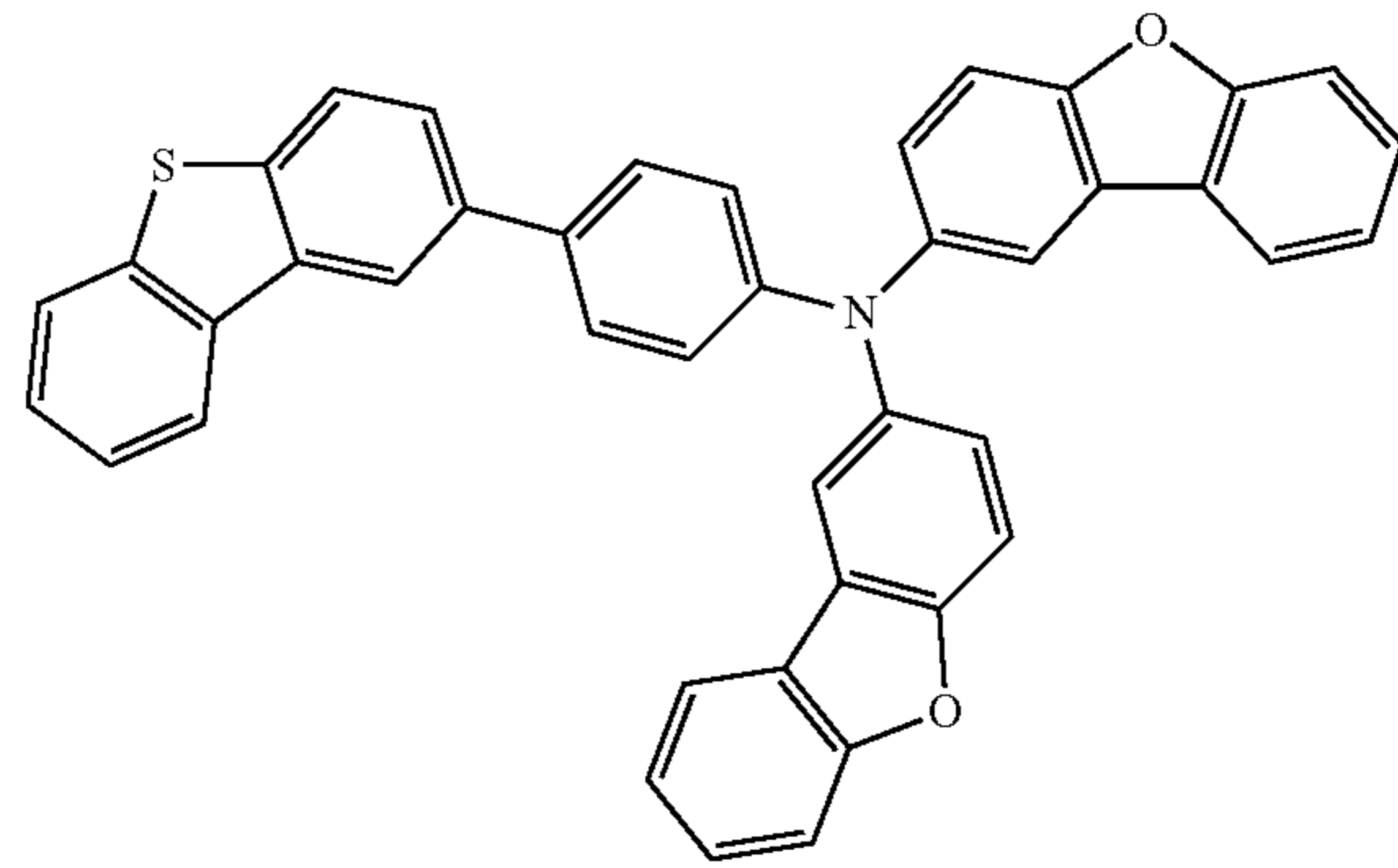


202

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1-40'

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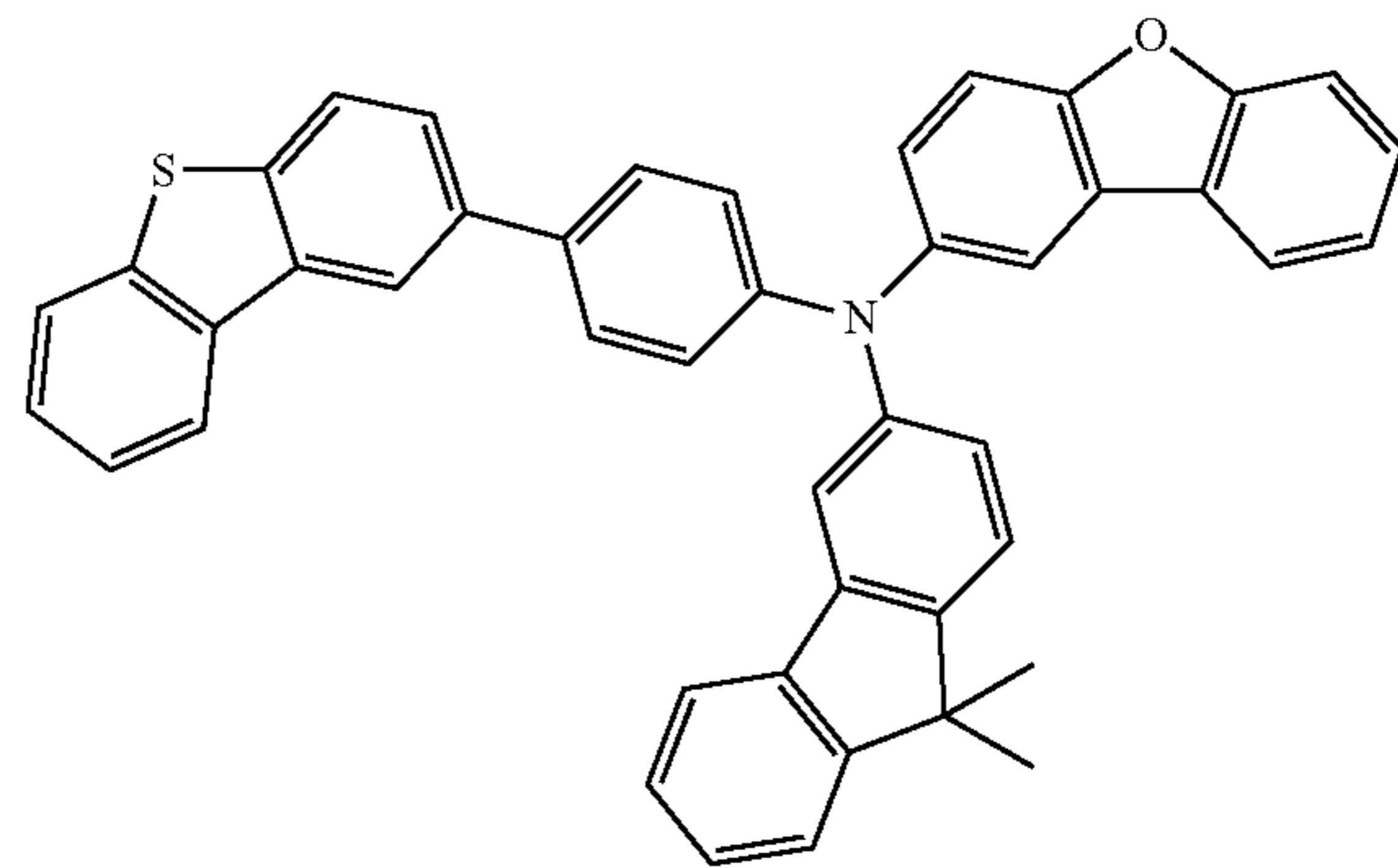


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1-41'

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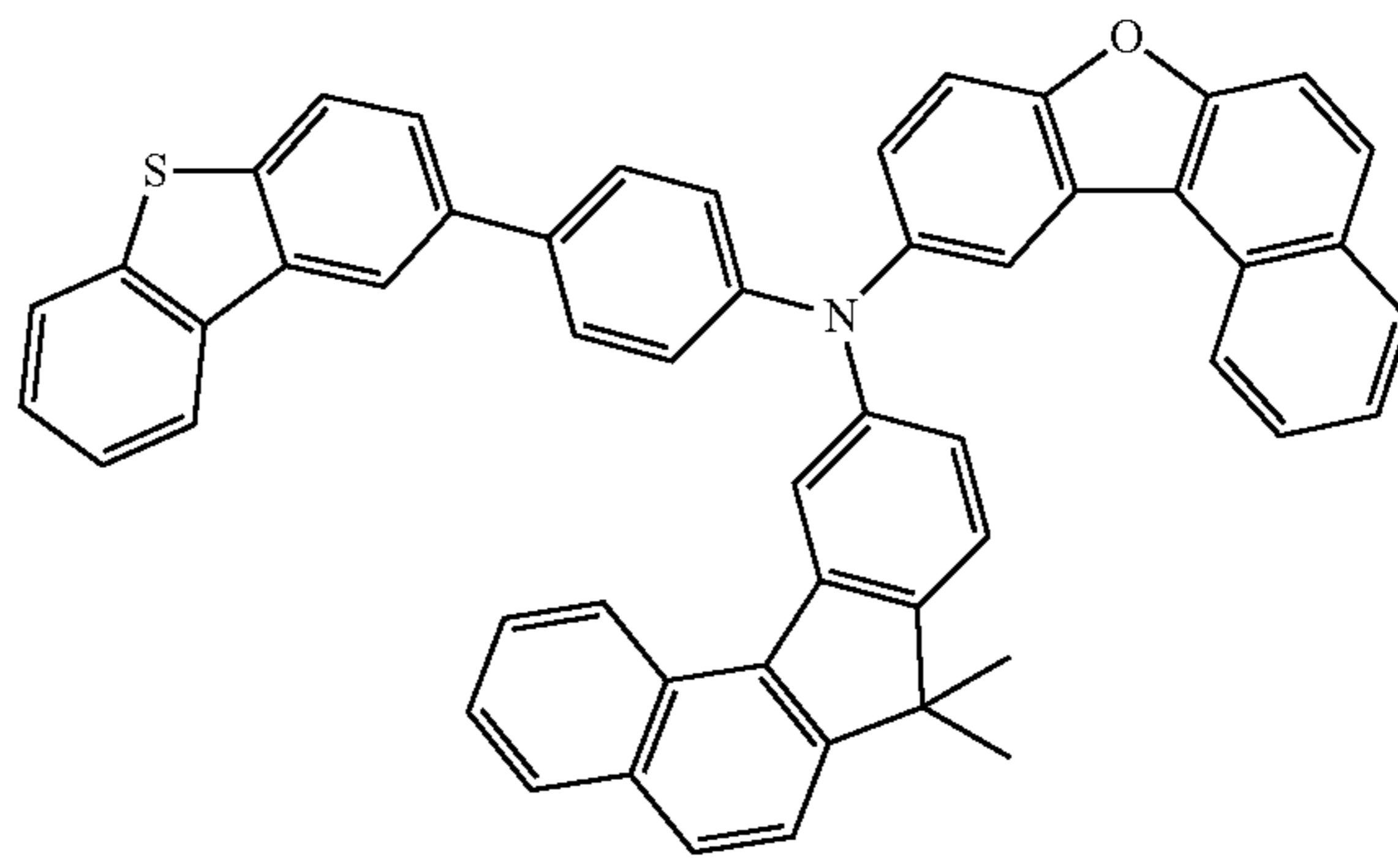


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1-42'

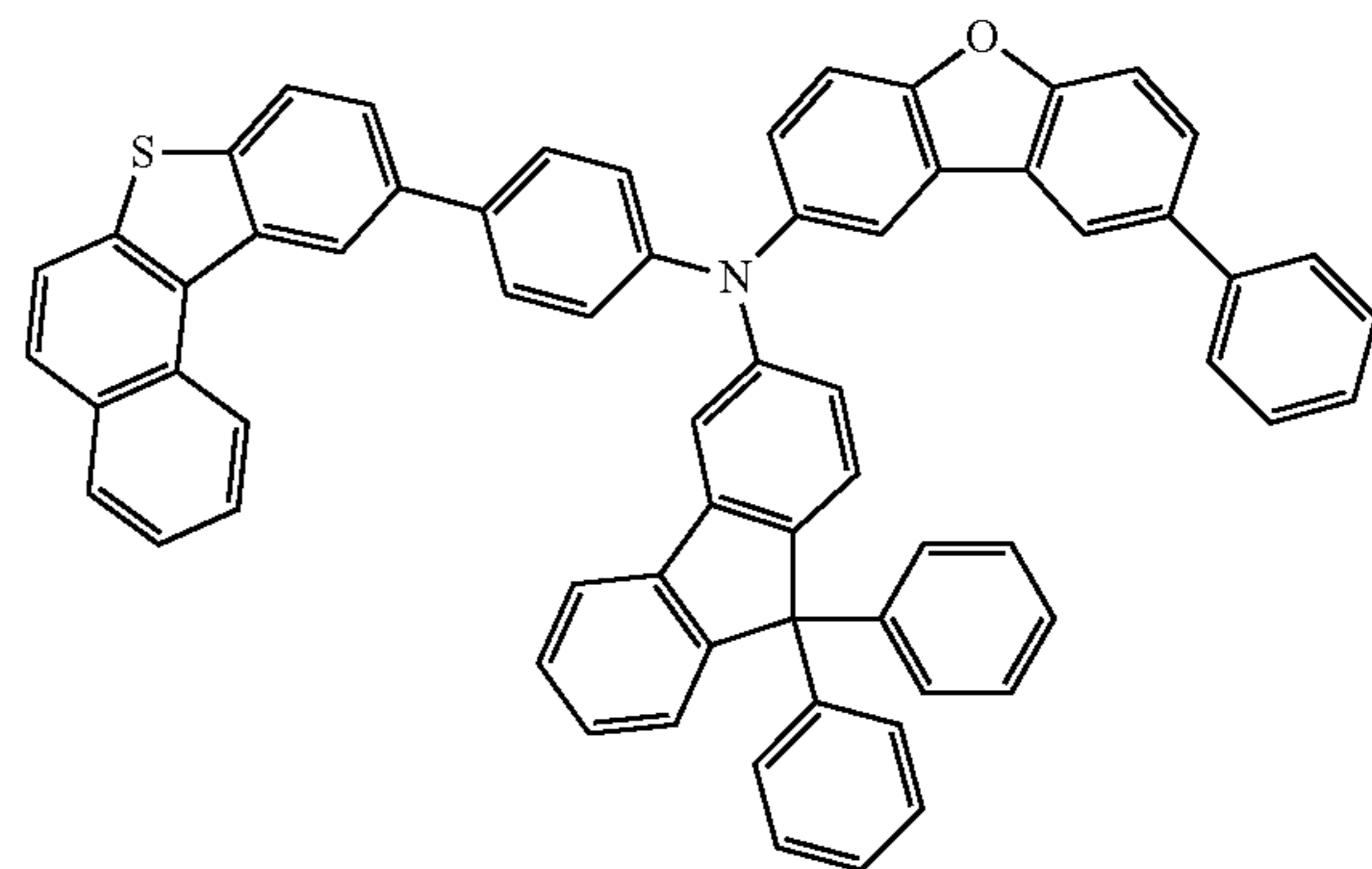
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1-43'

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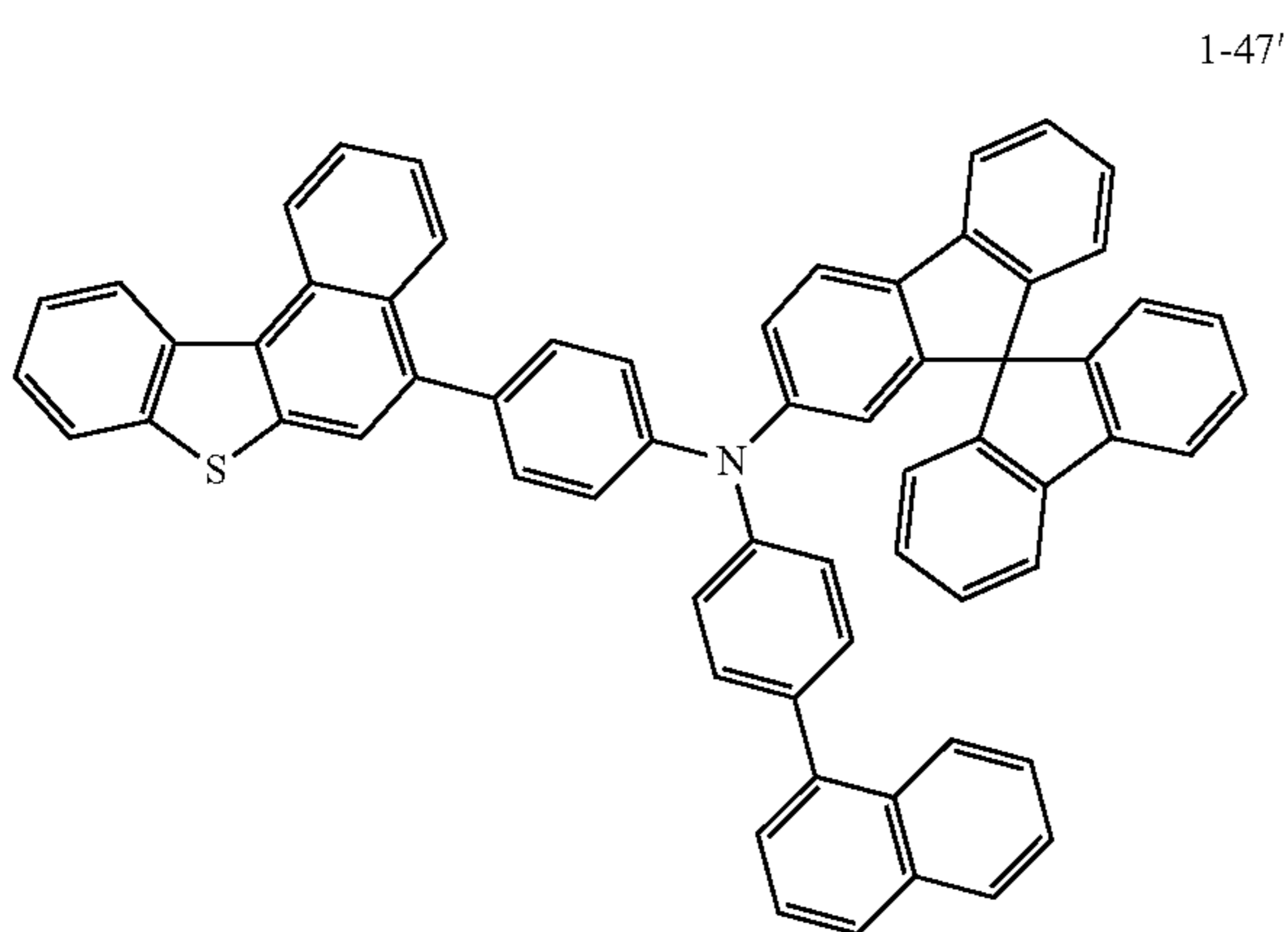
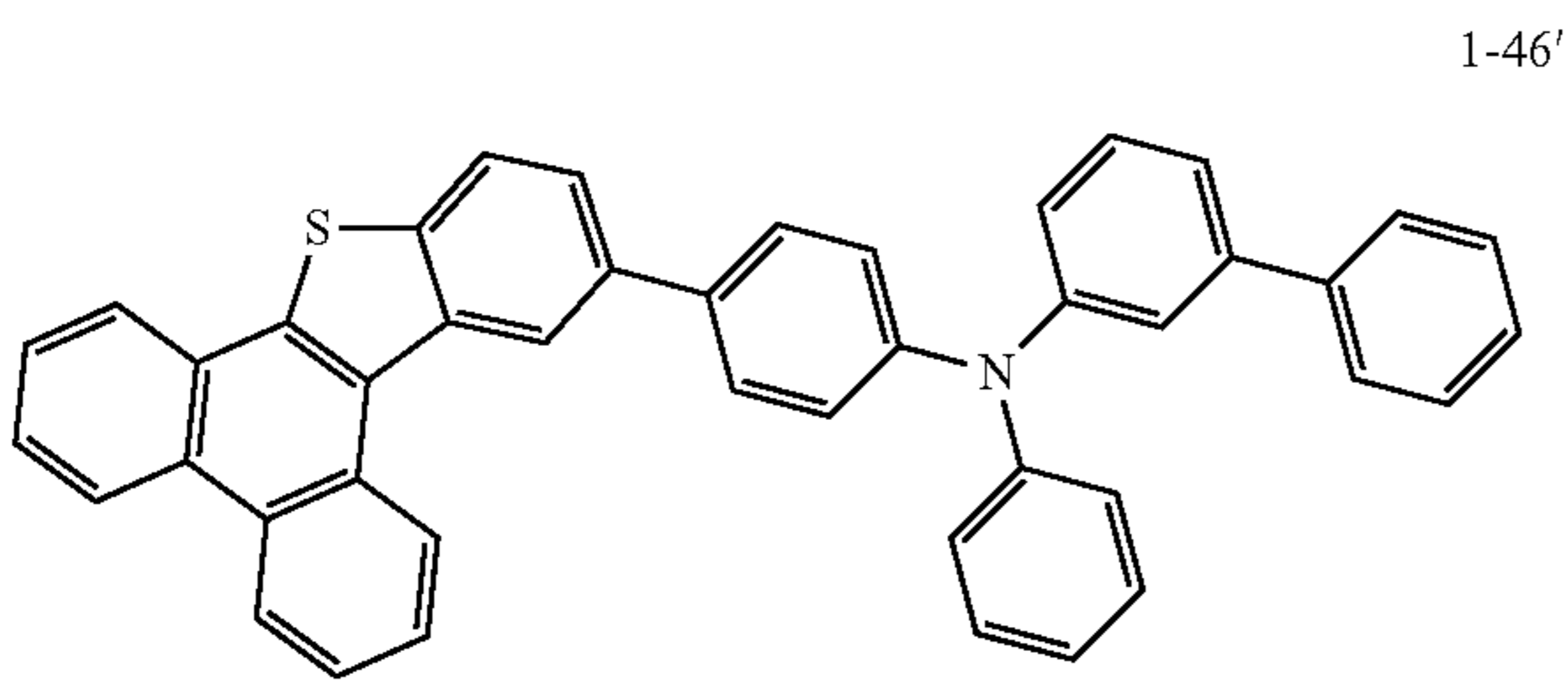
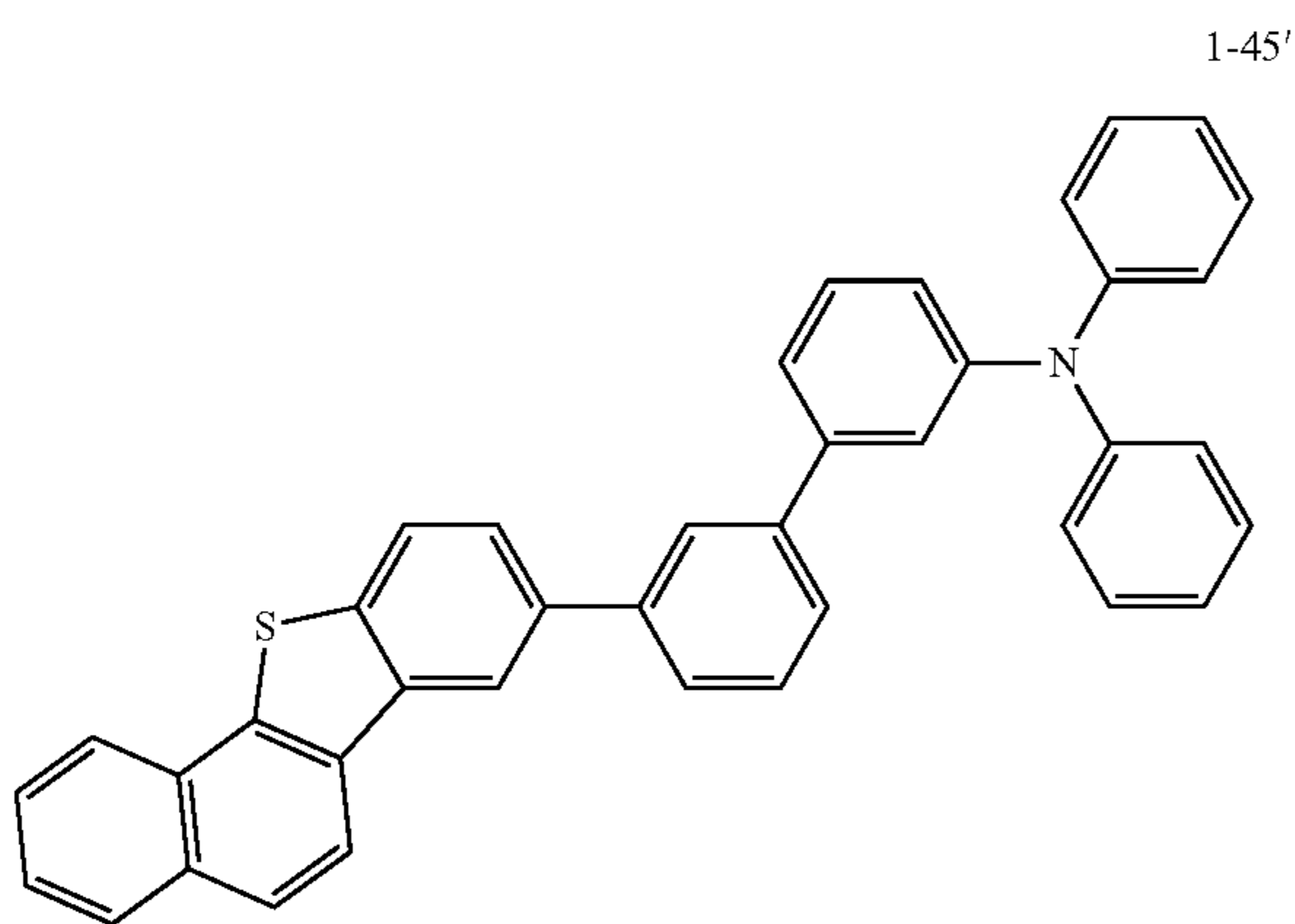
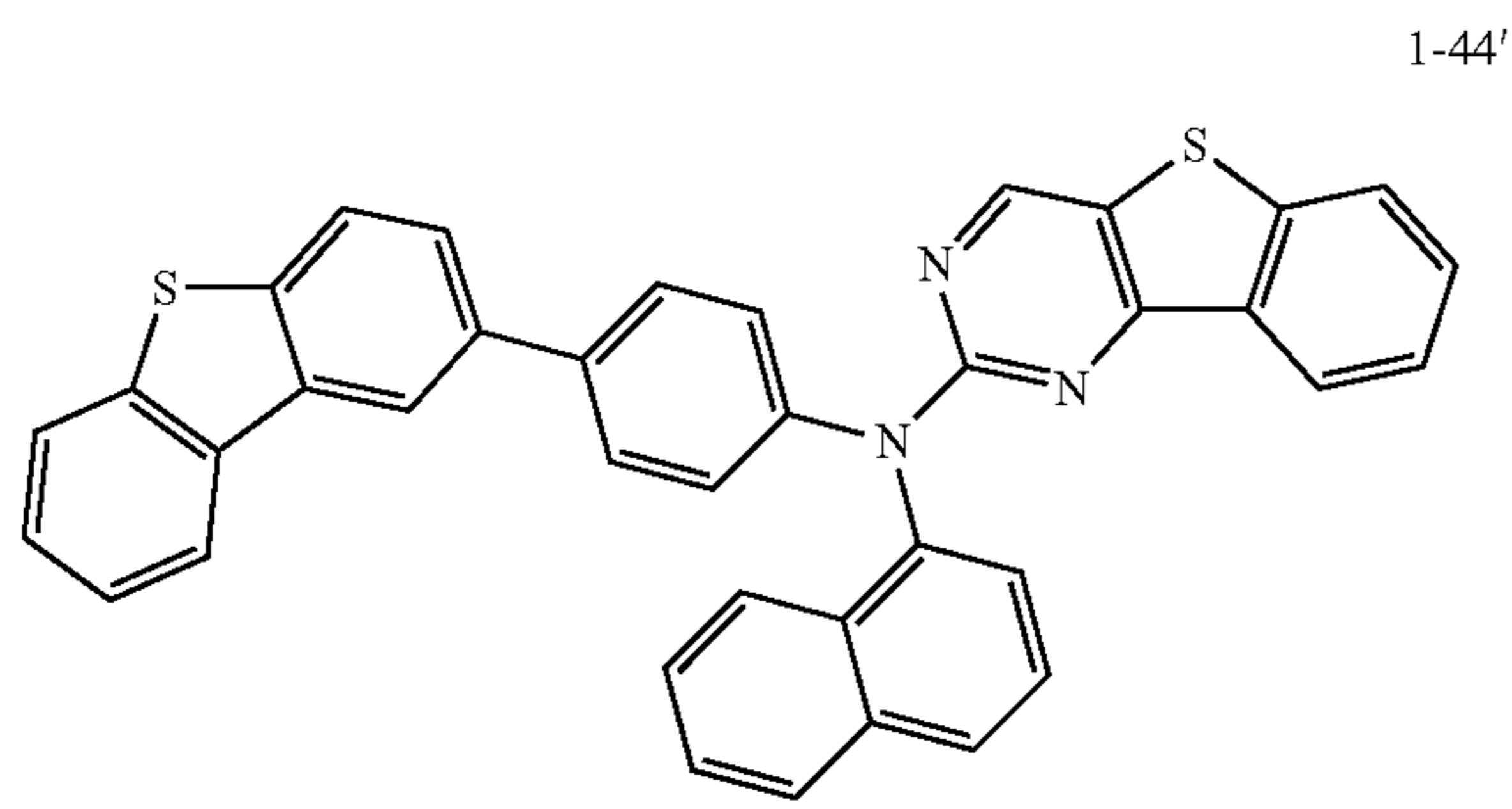
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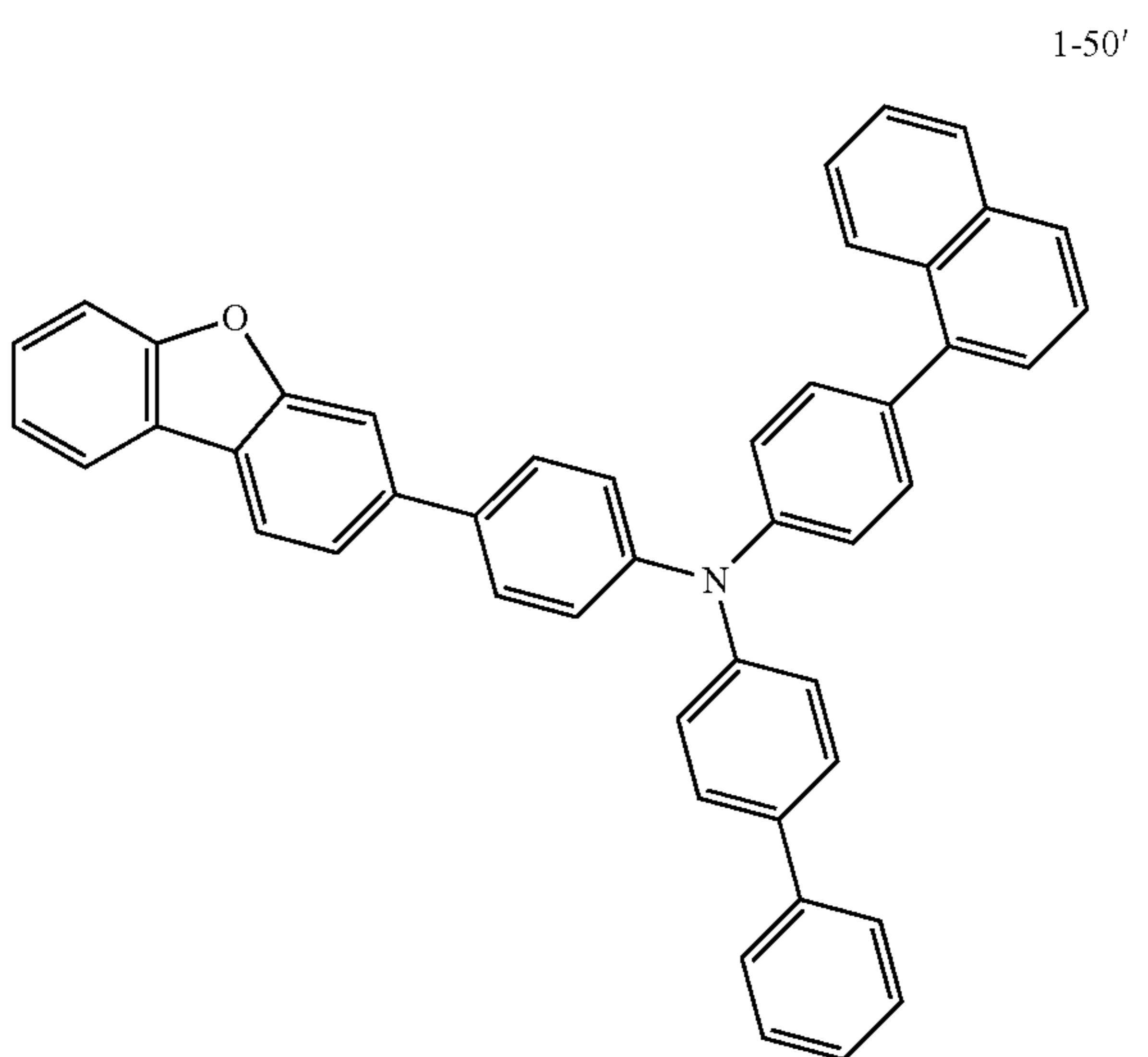
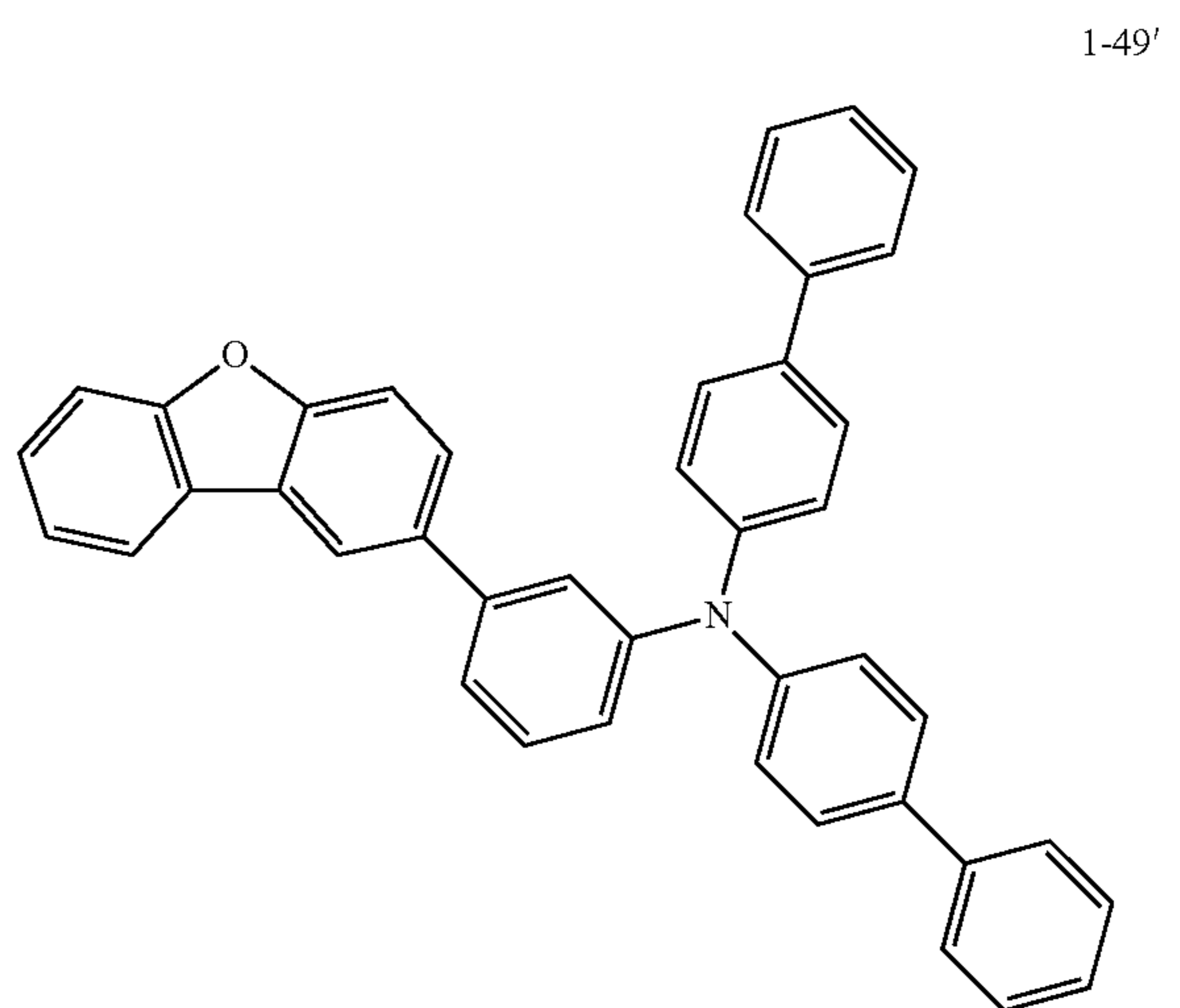
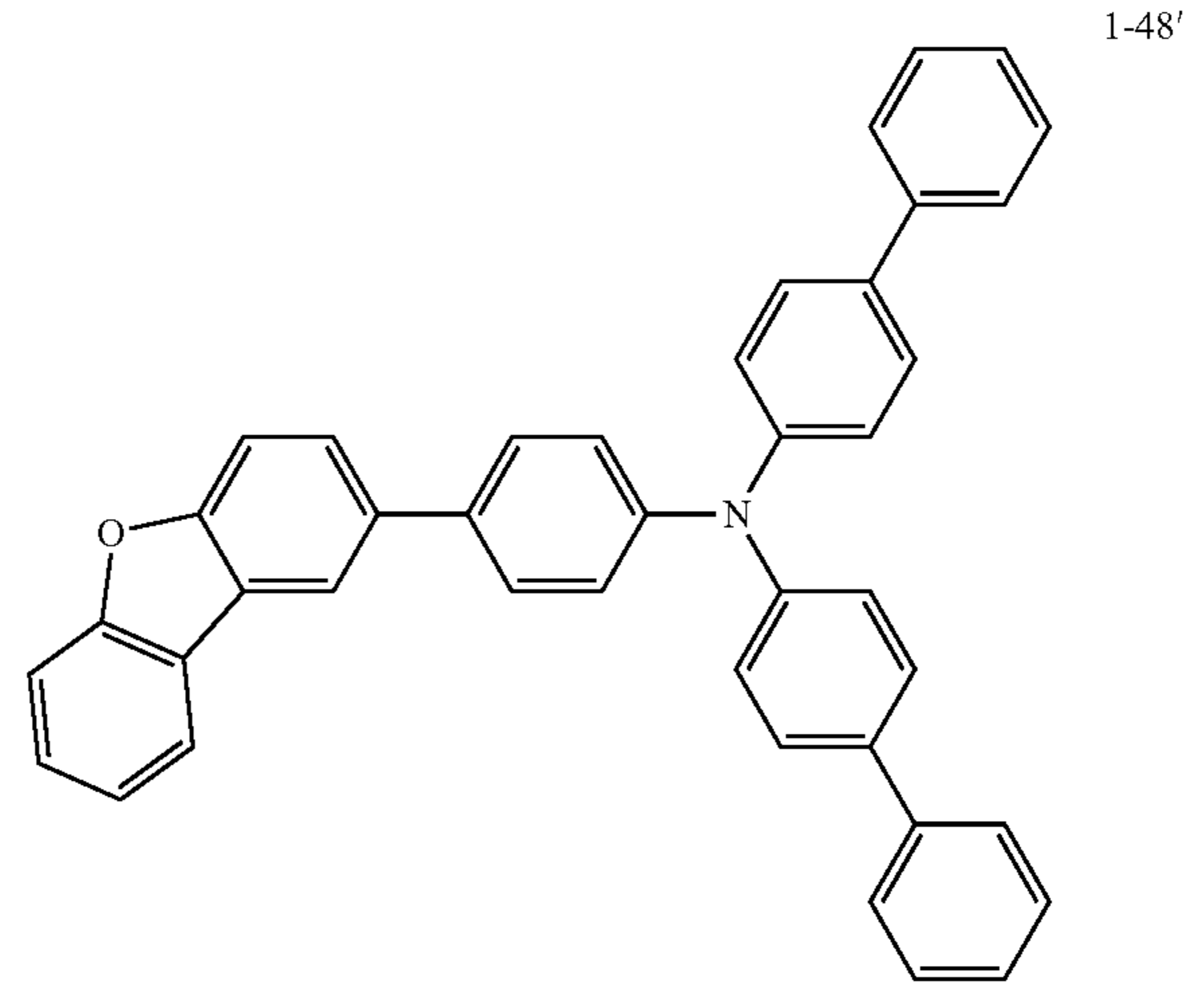
203

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204

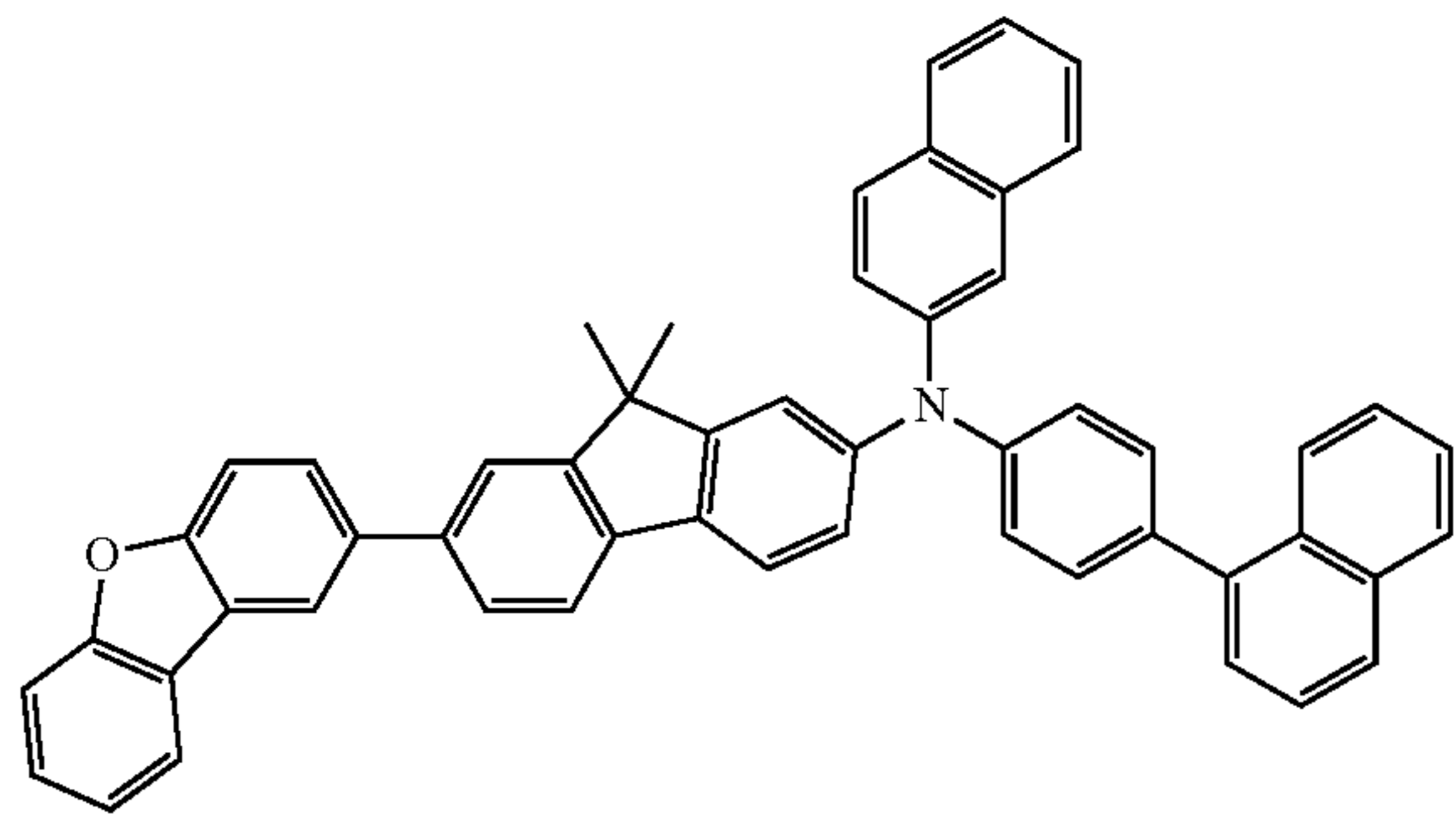
-continued



205

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1-51'



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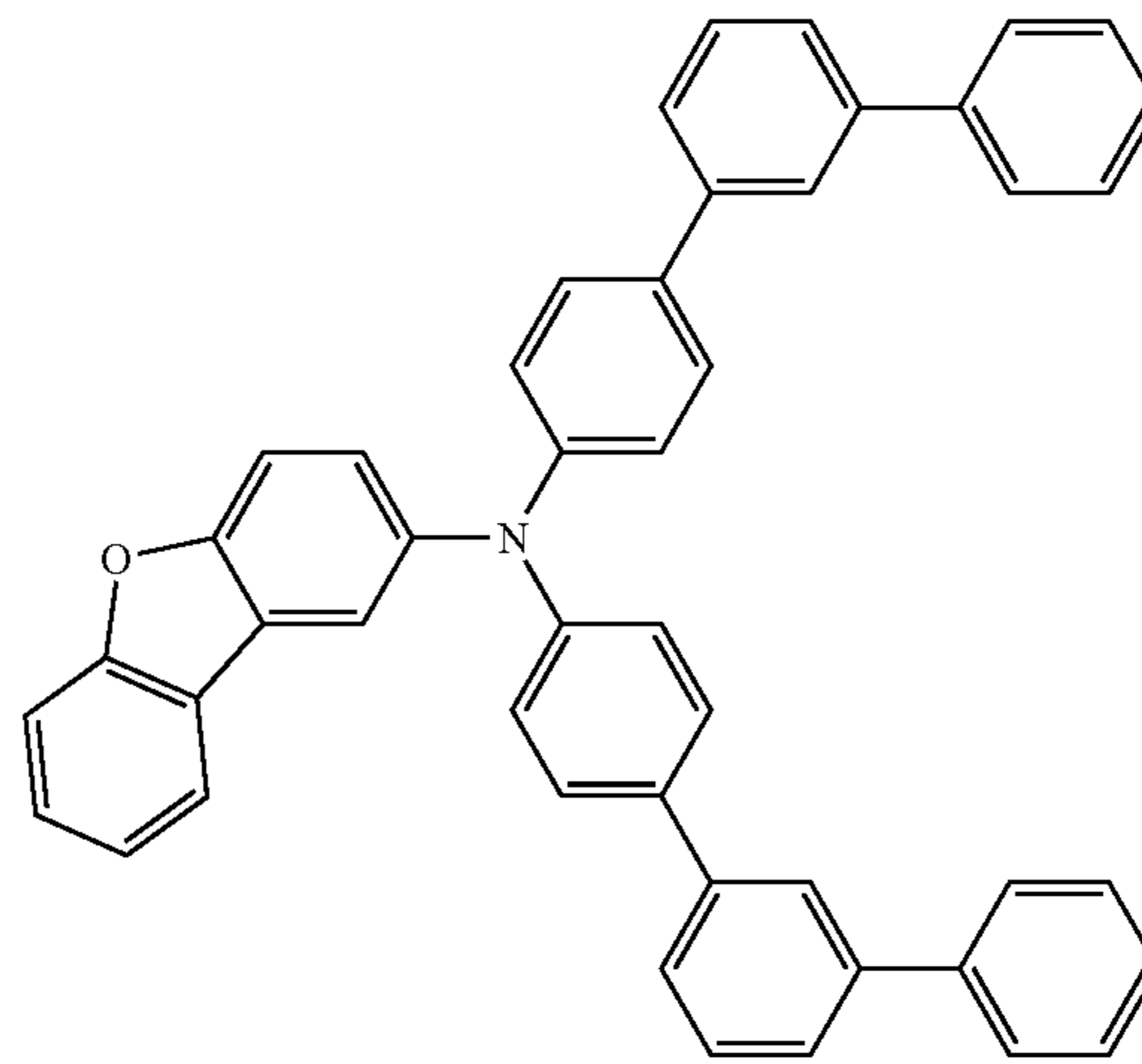
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206

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1-54'



1-52'

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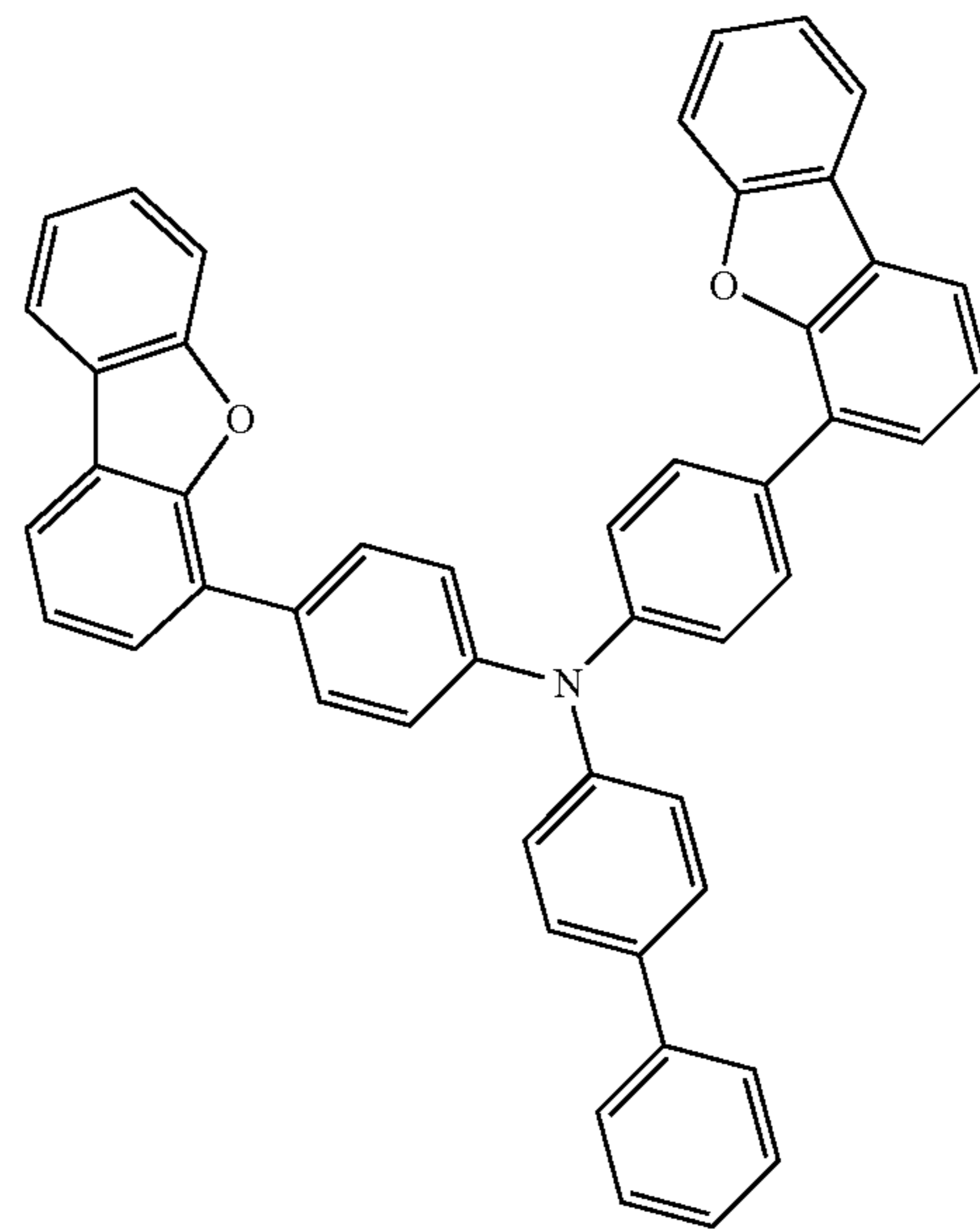
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1-55'



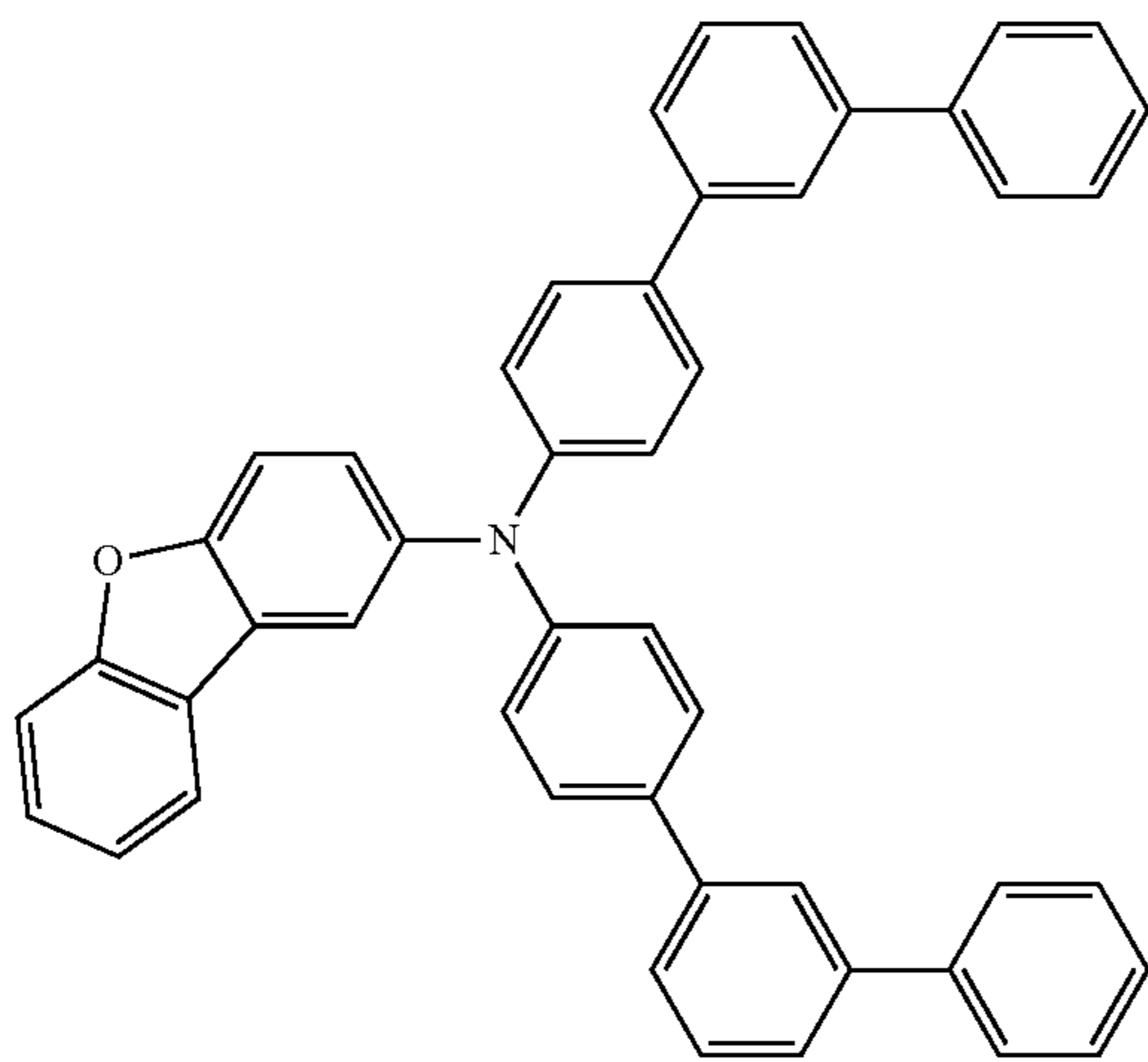
1-53'

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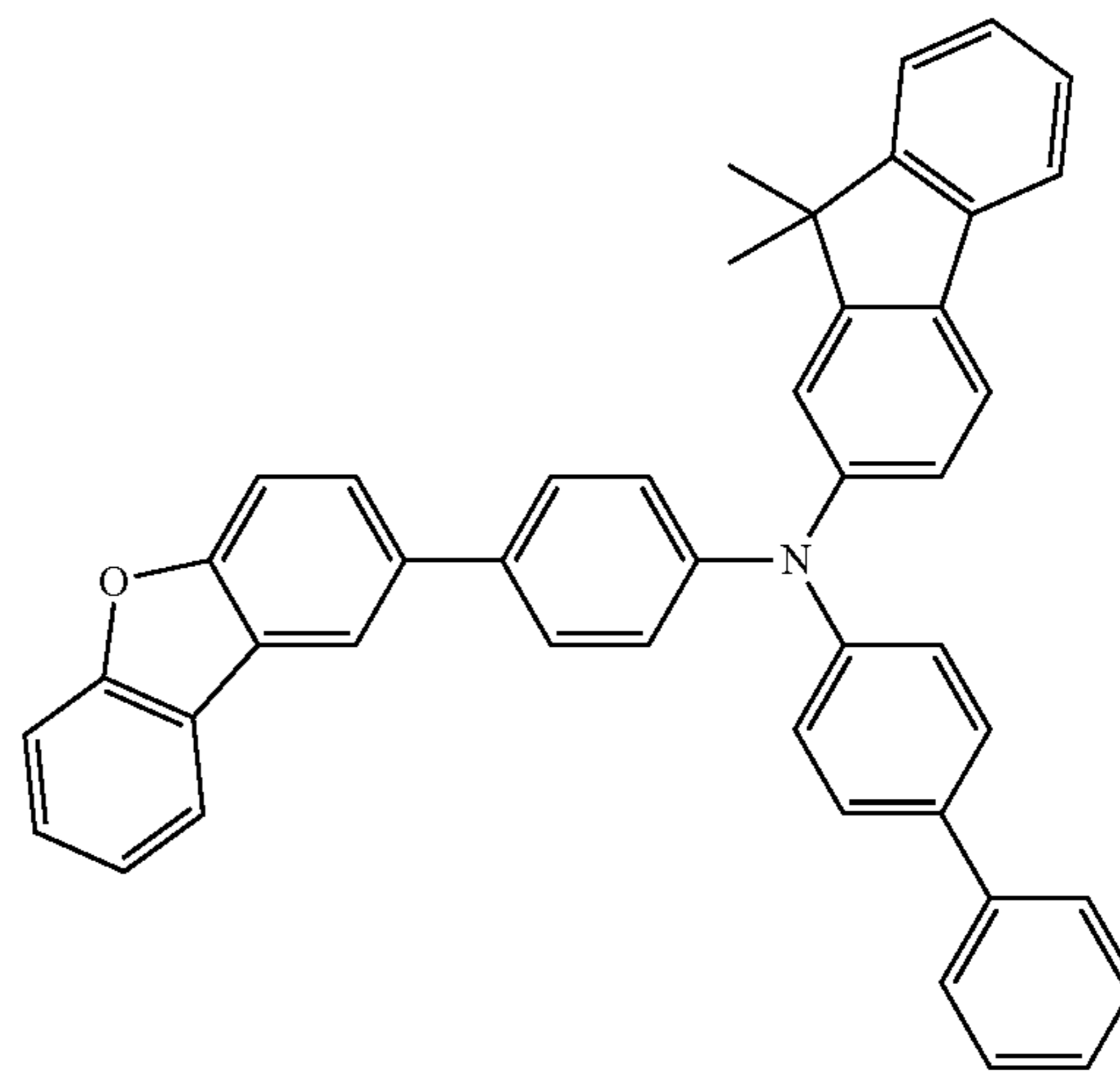
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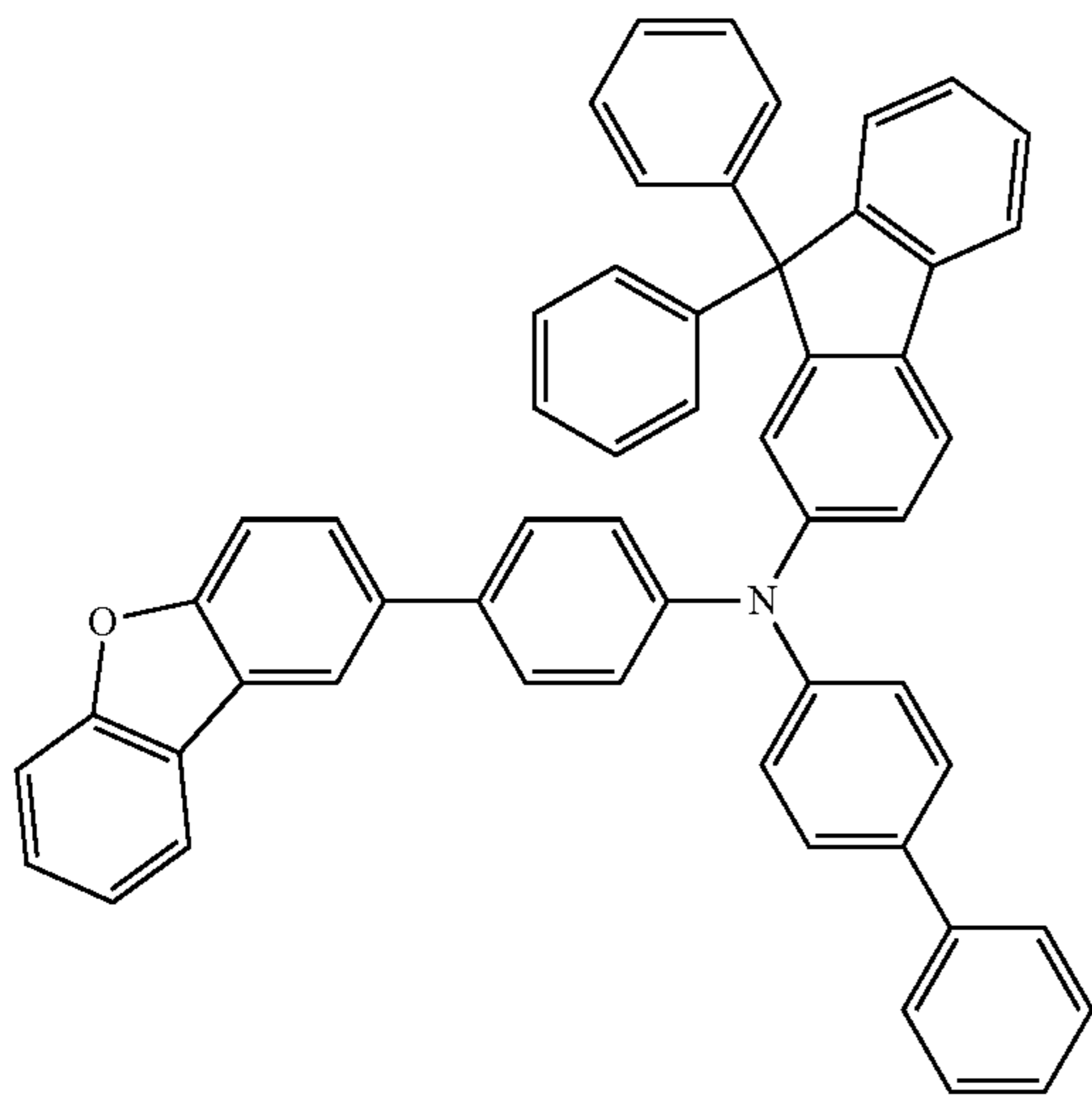


1-56'



207

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1-57'

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1-58'

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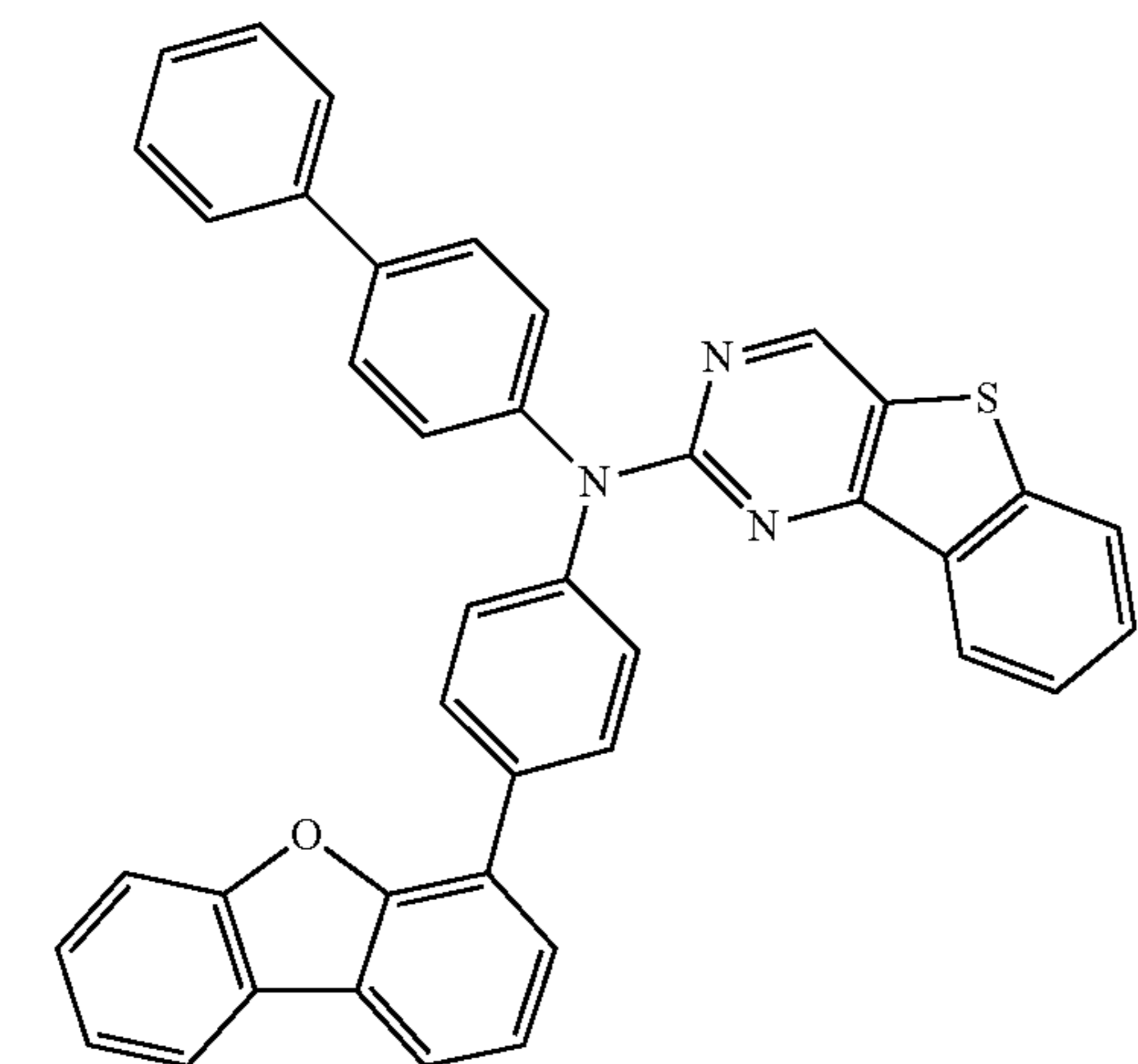
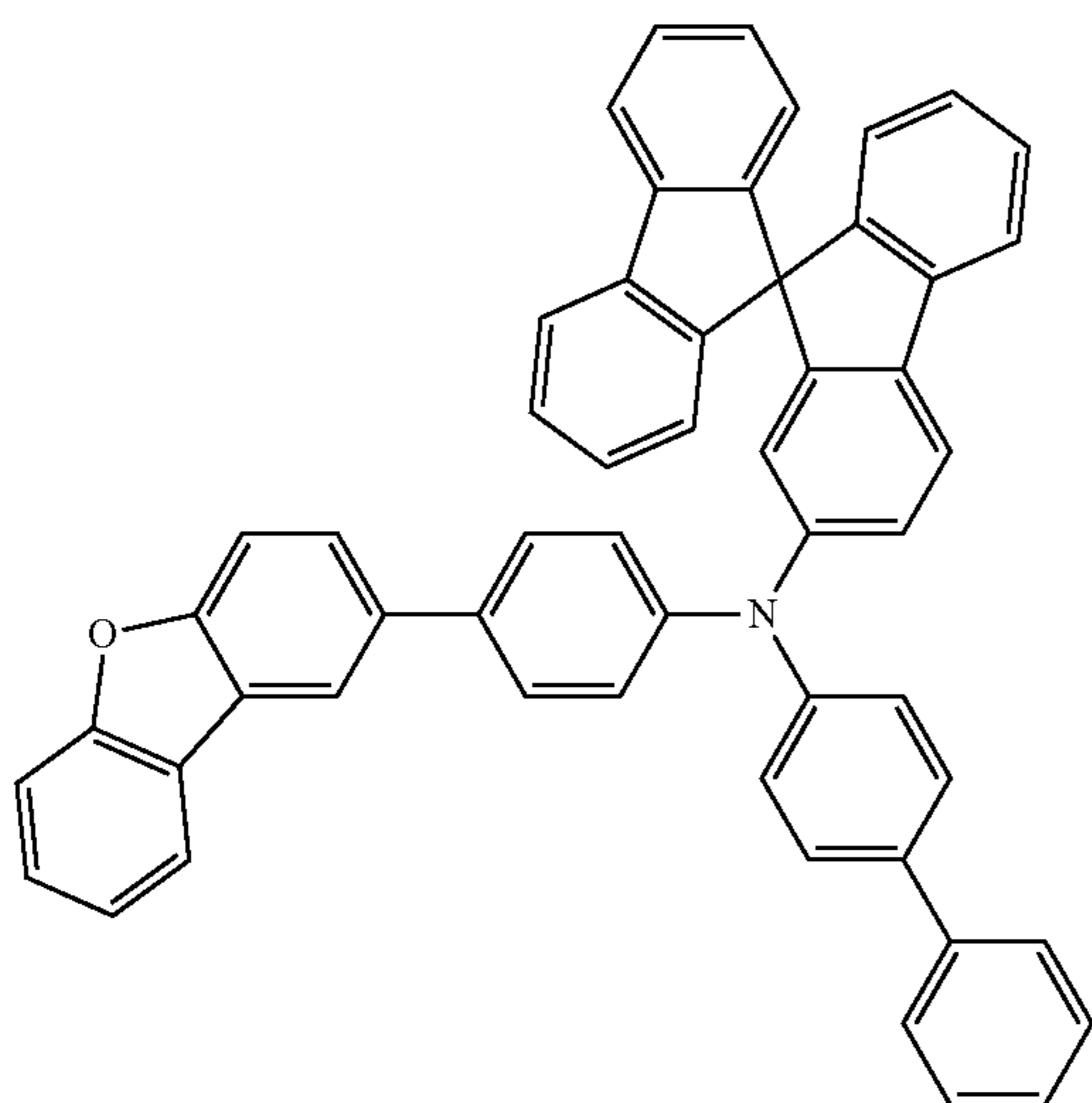
1-59'

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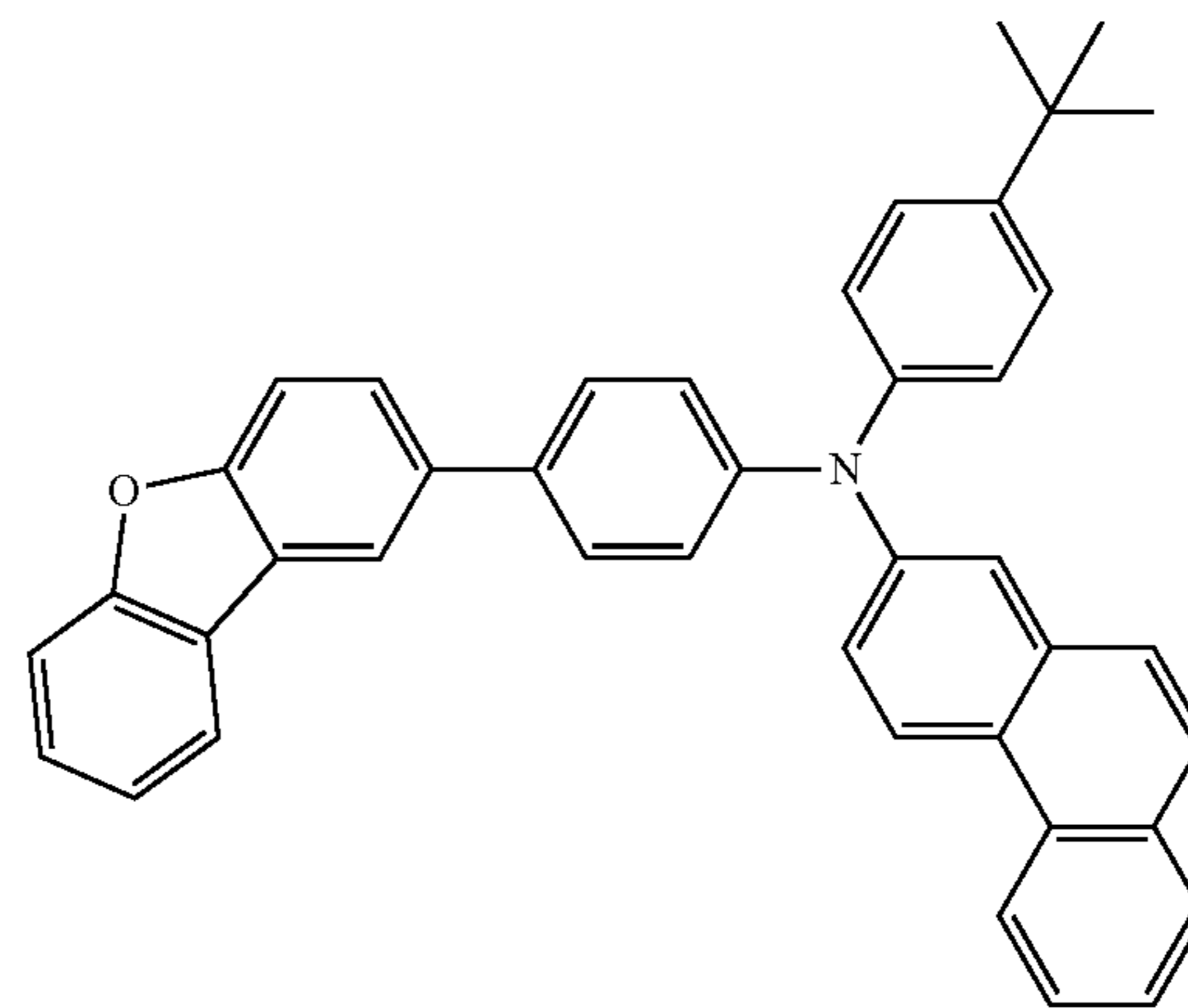
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208

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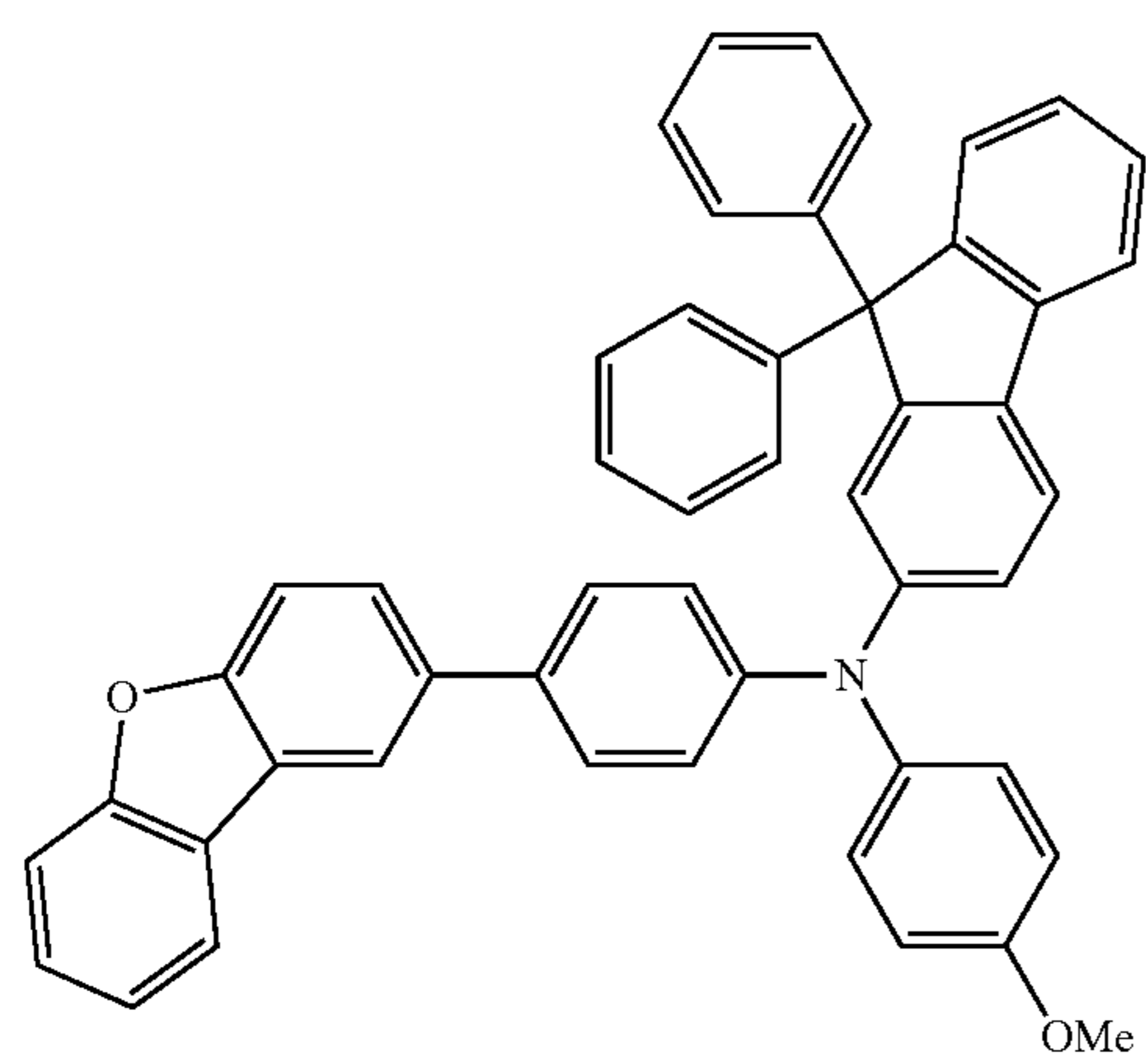
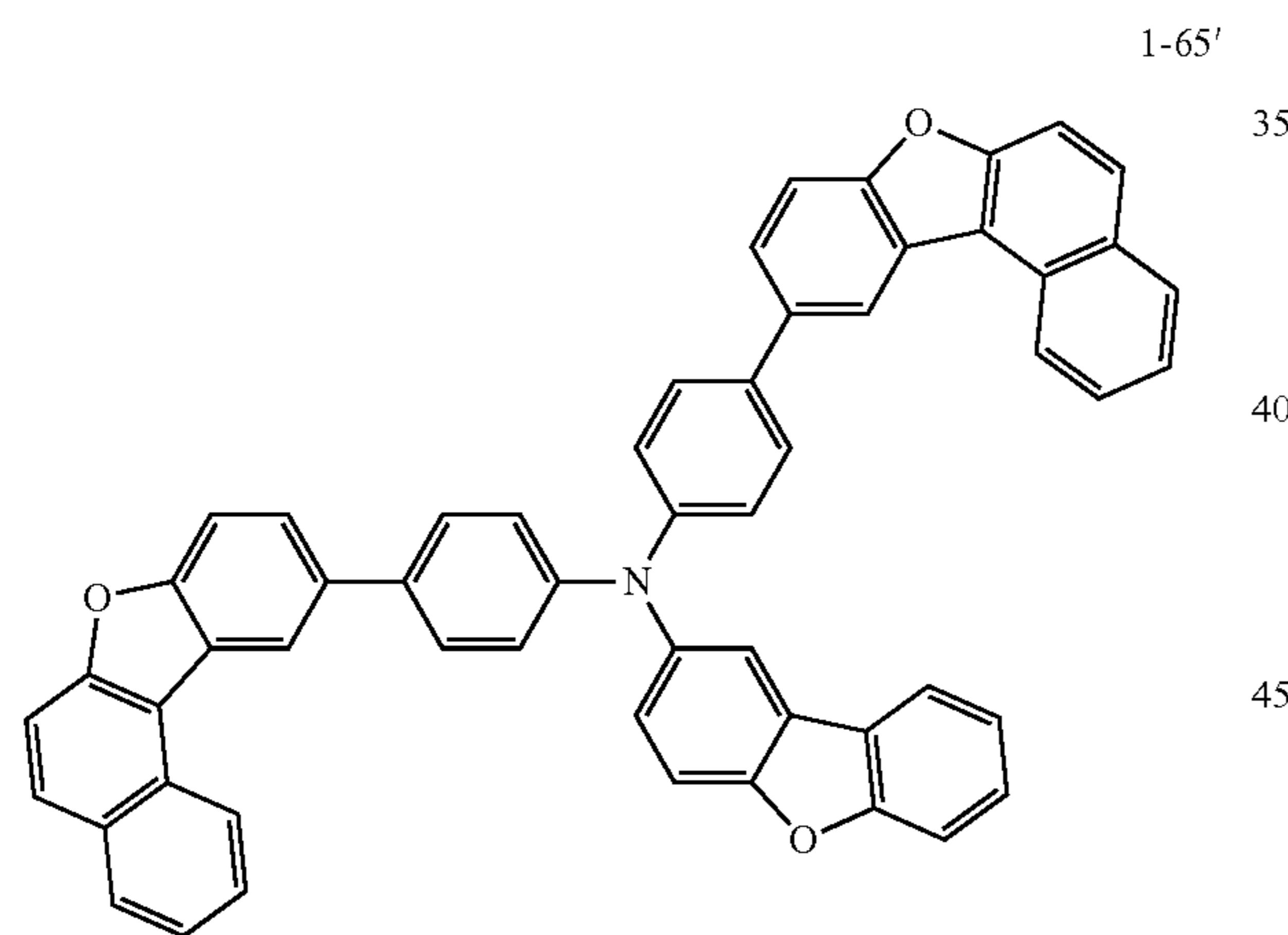
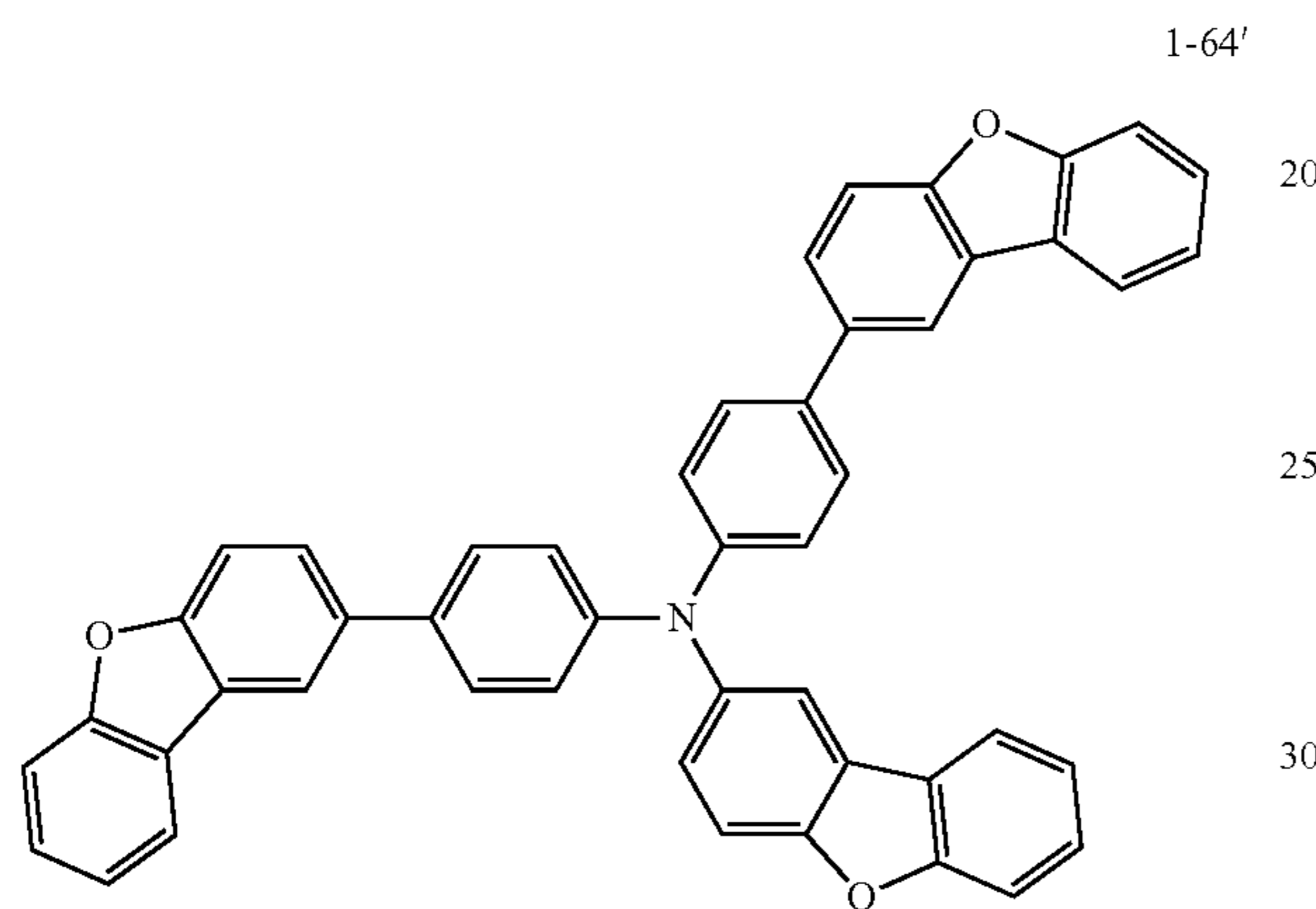
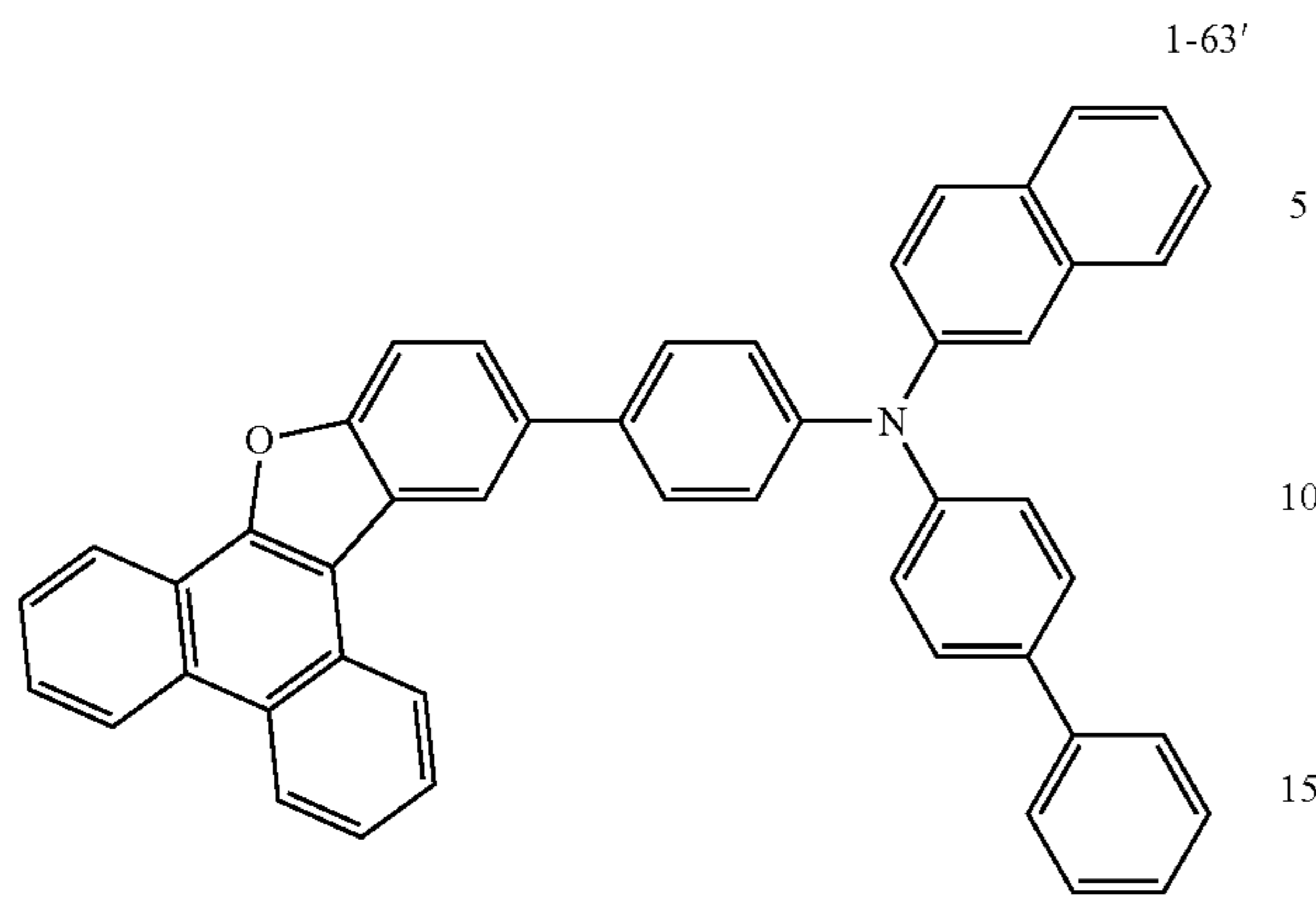
1-60'

1-61'

1-62'

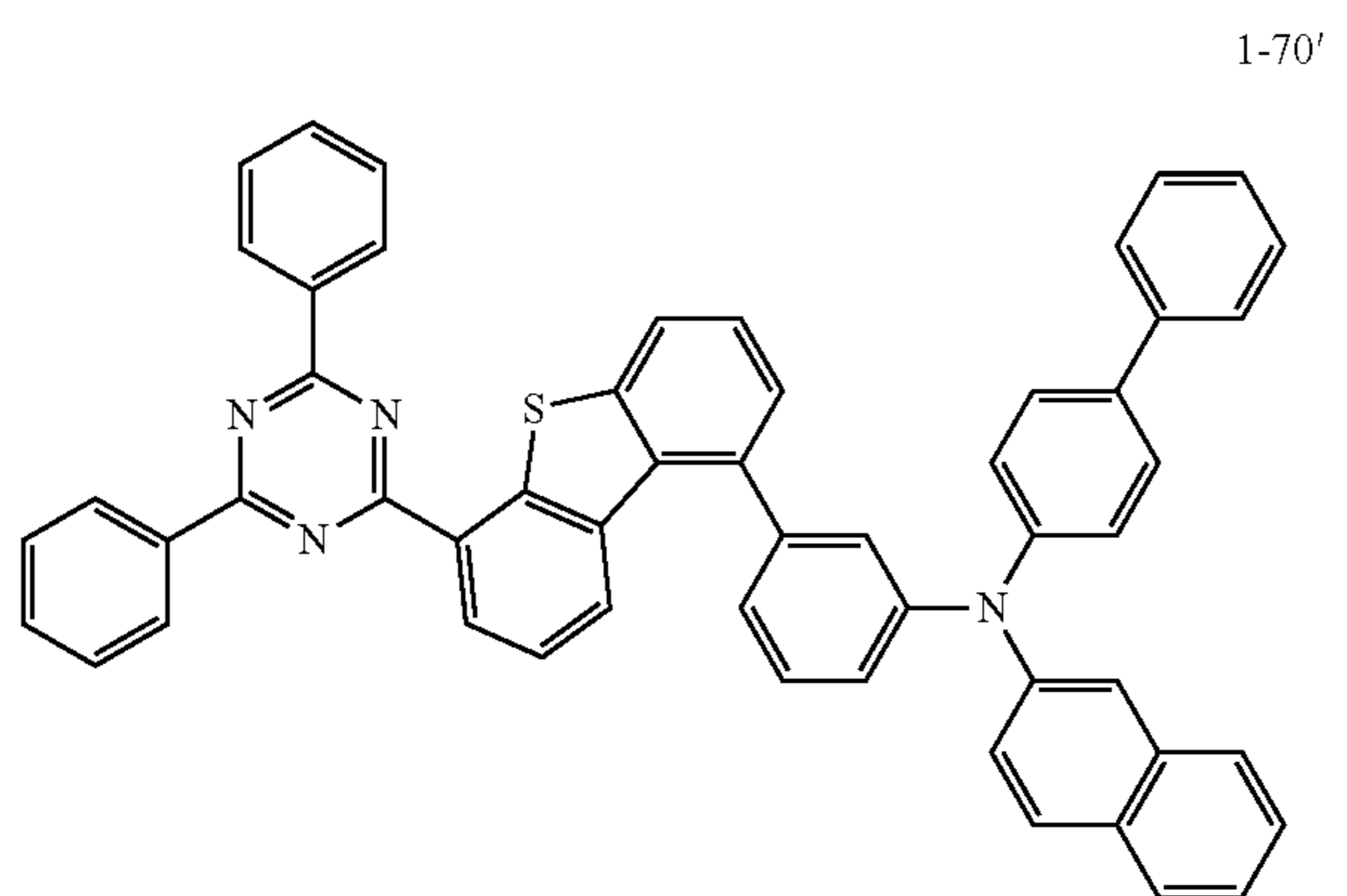
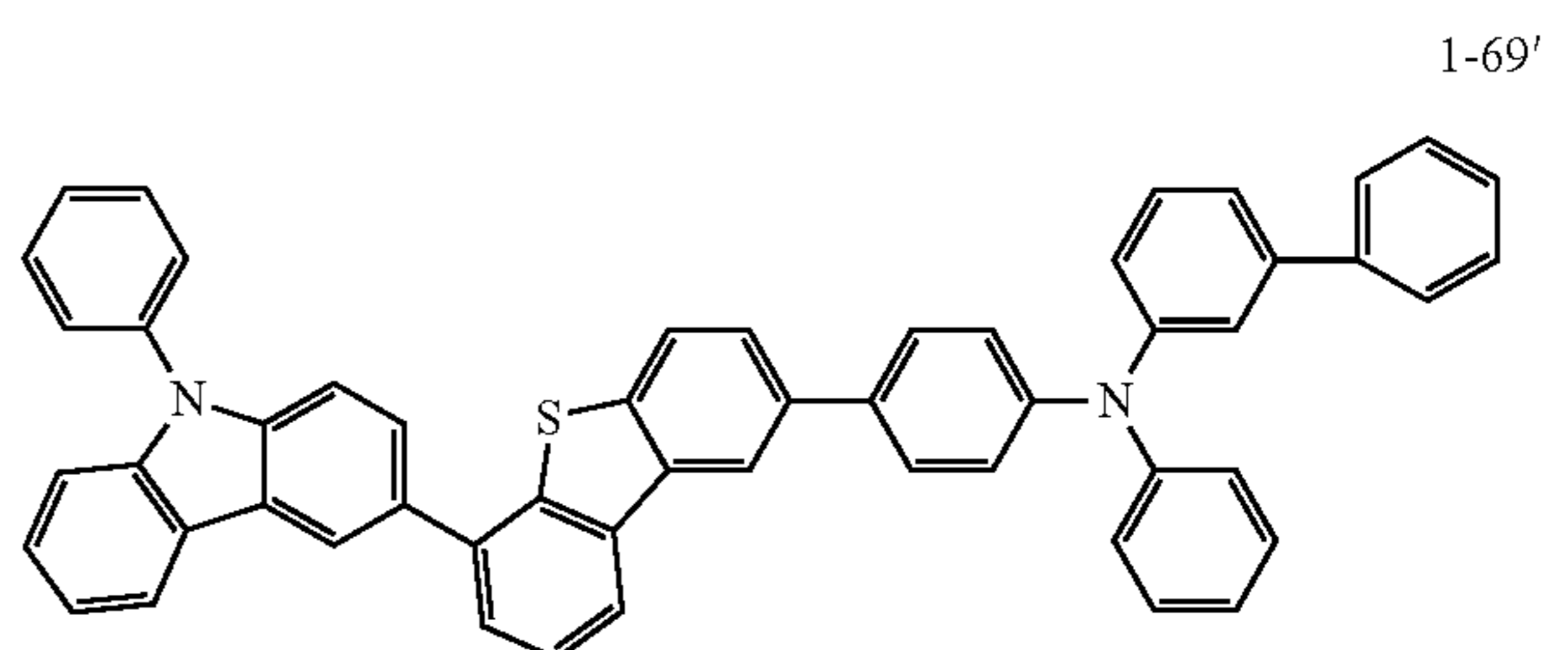
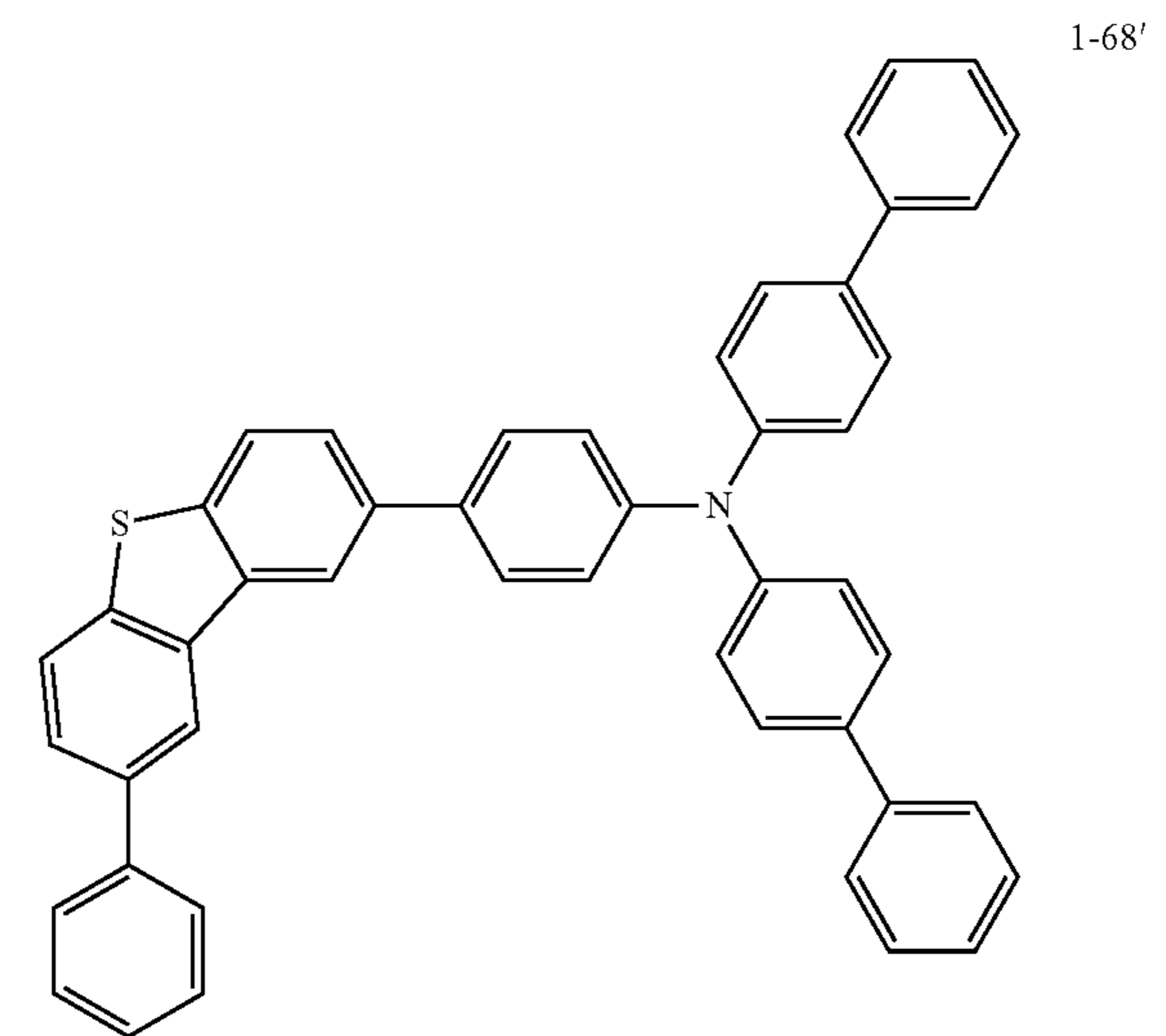
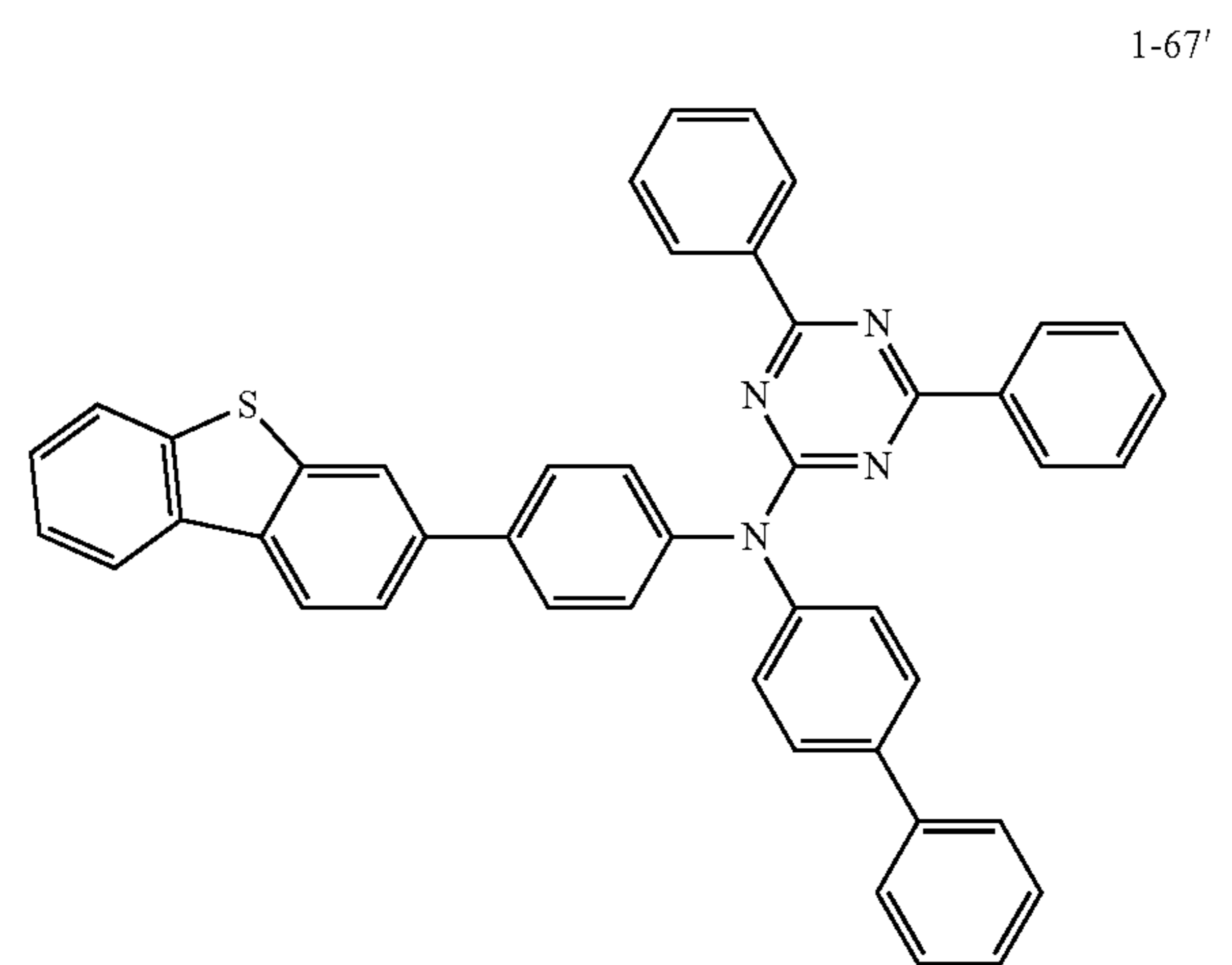
209

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210

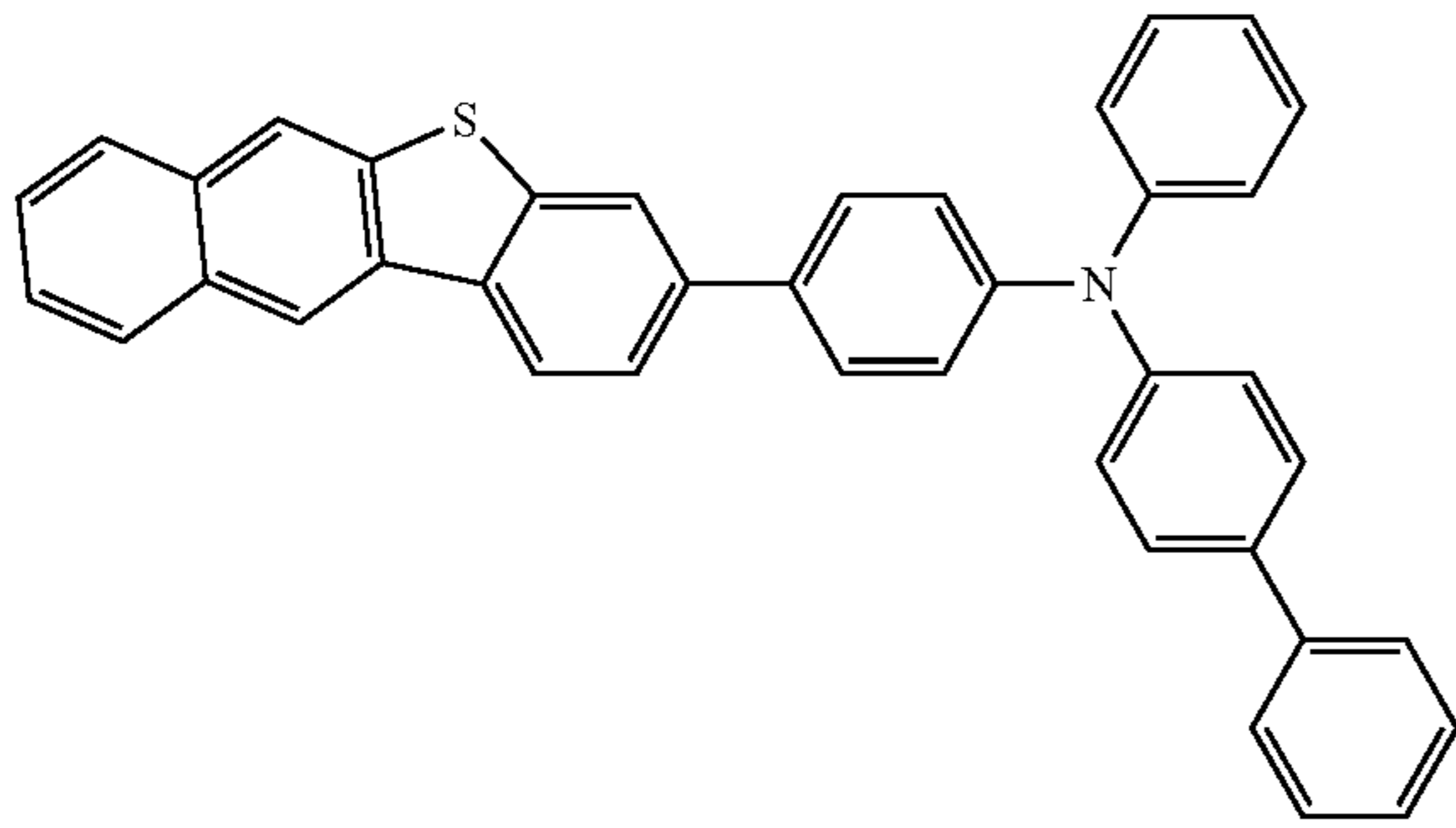
-continued



211

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1-71'

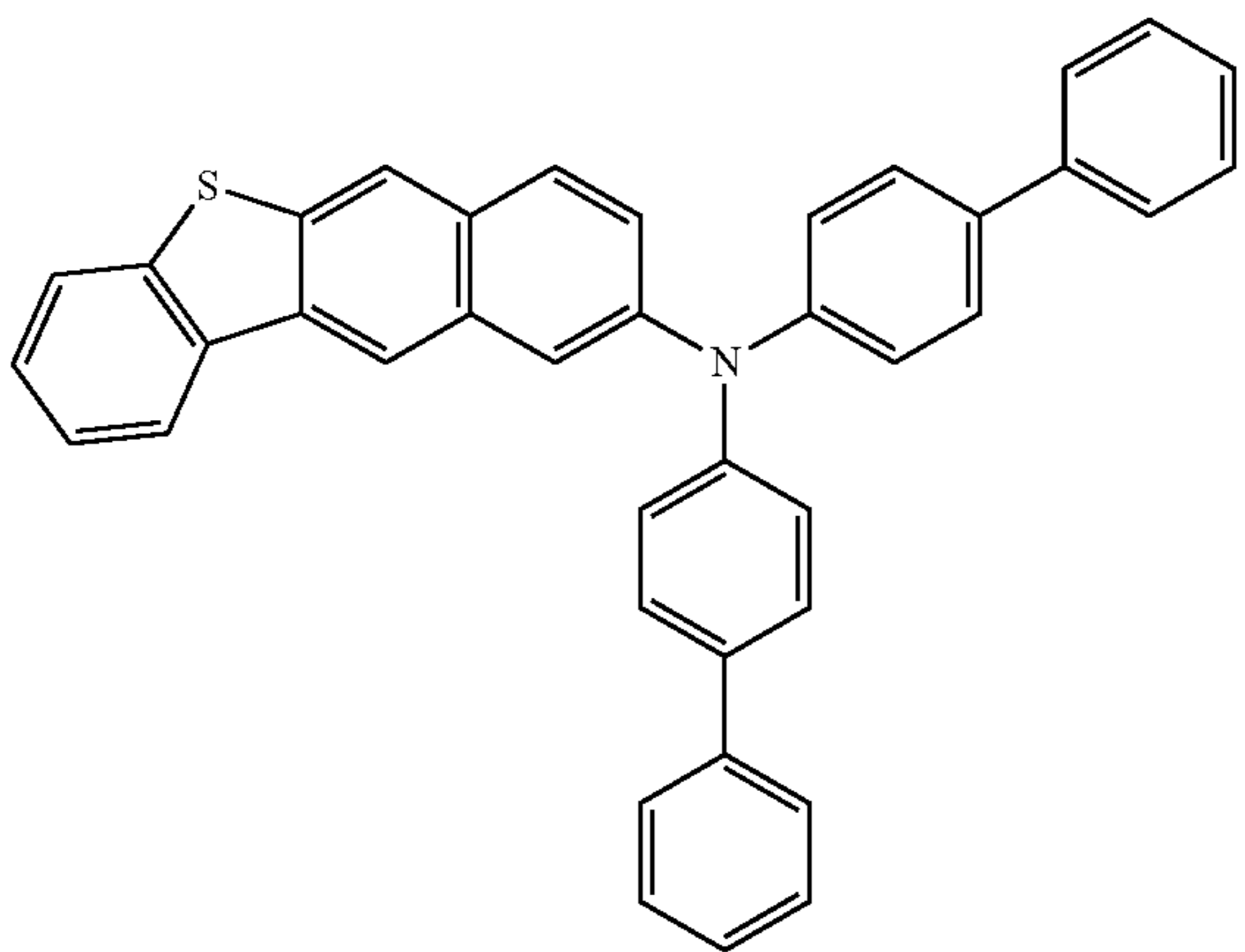


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1-72'

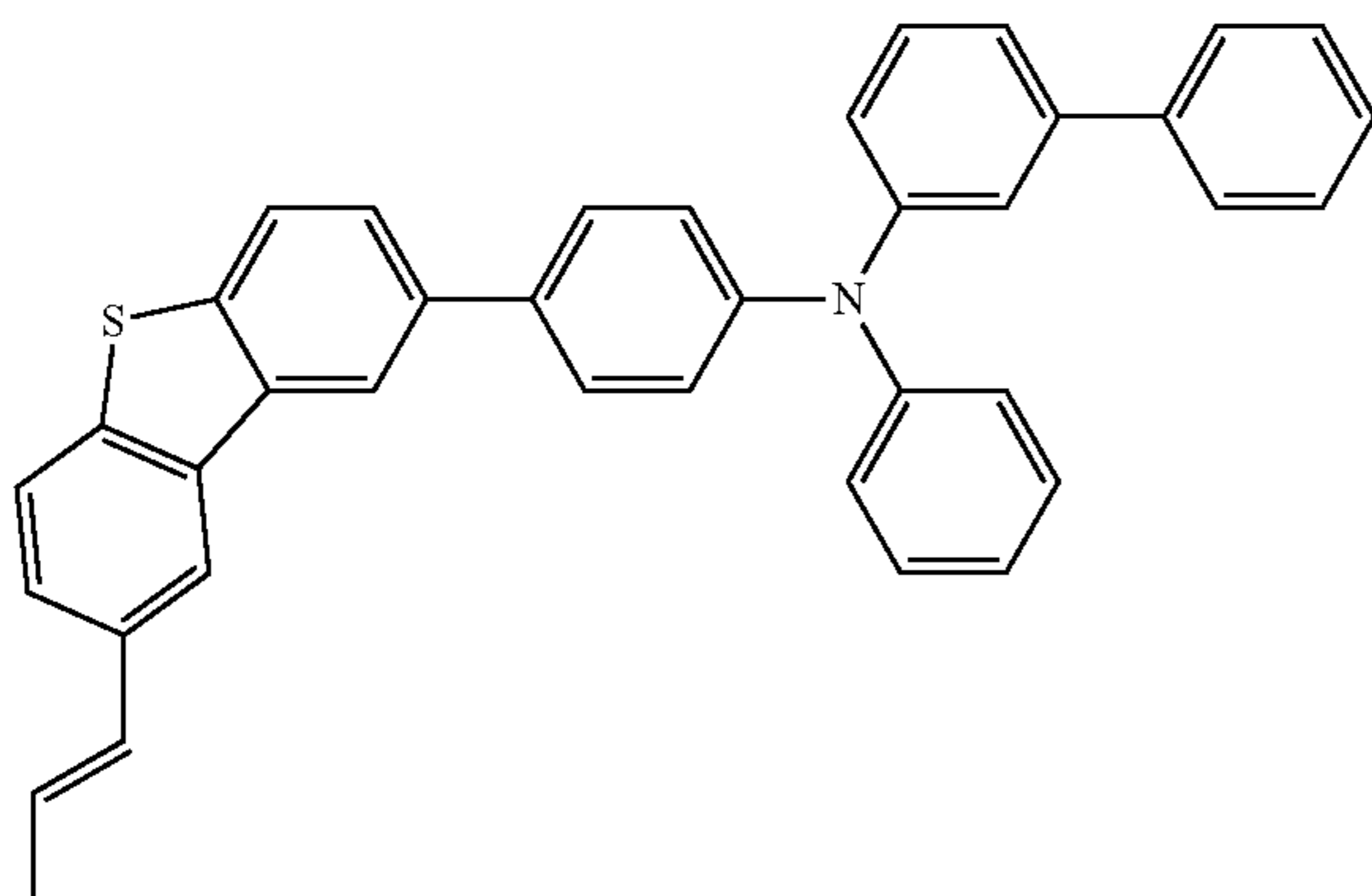


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1-73'

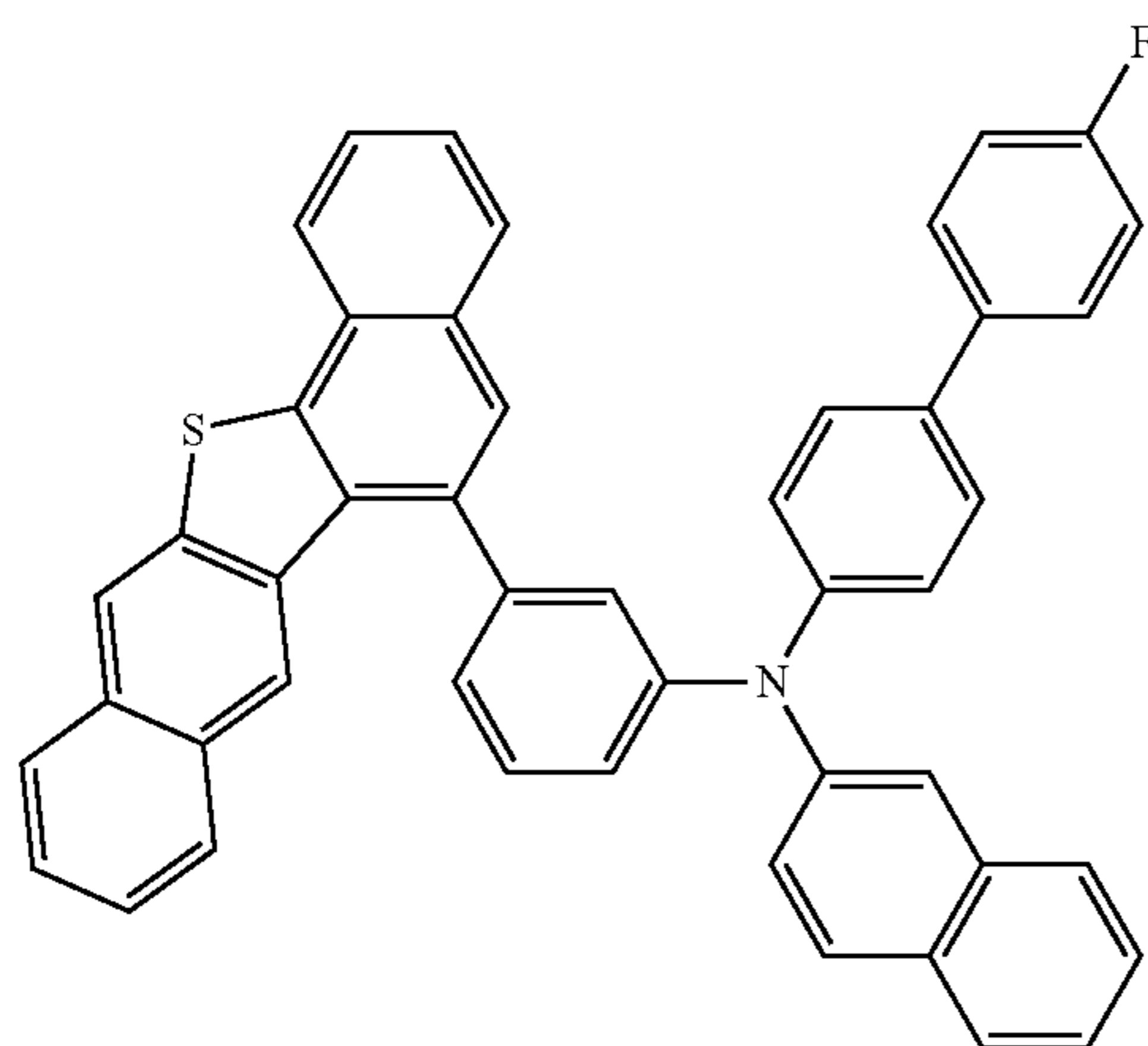


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1-74'



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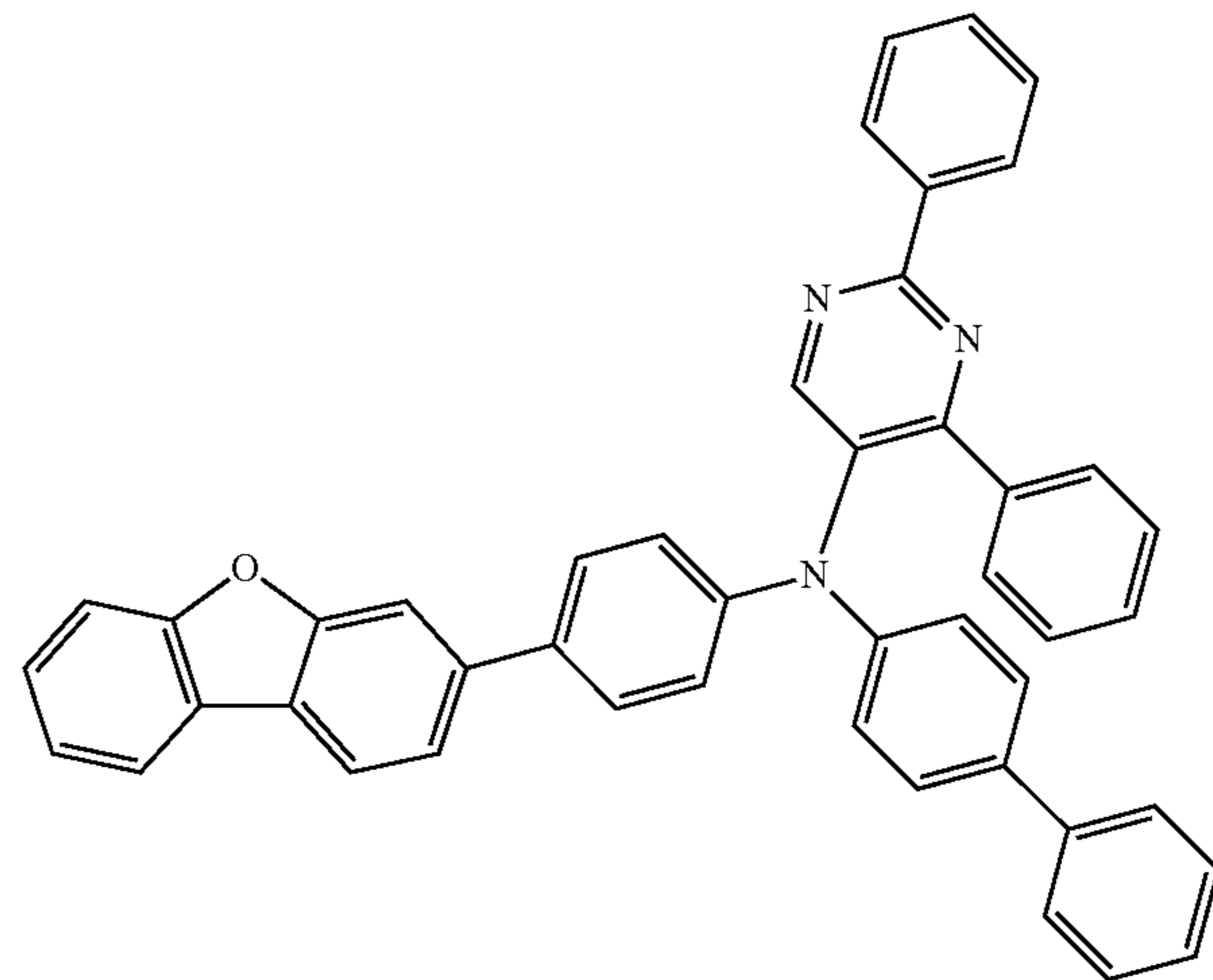
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212

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1-75'

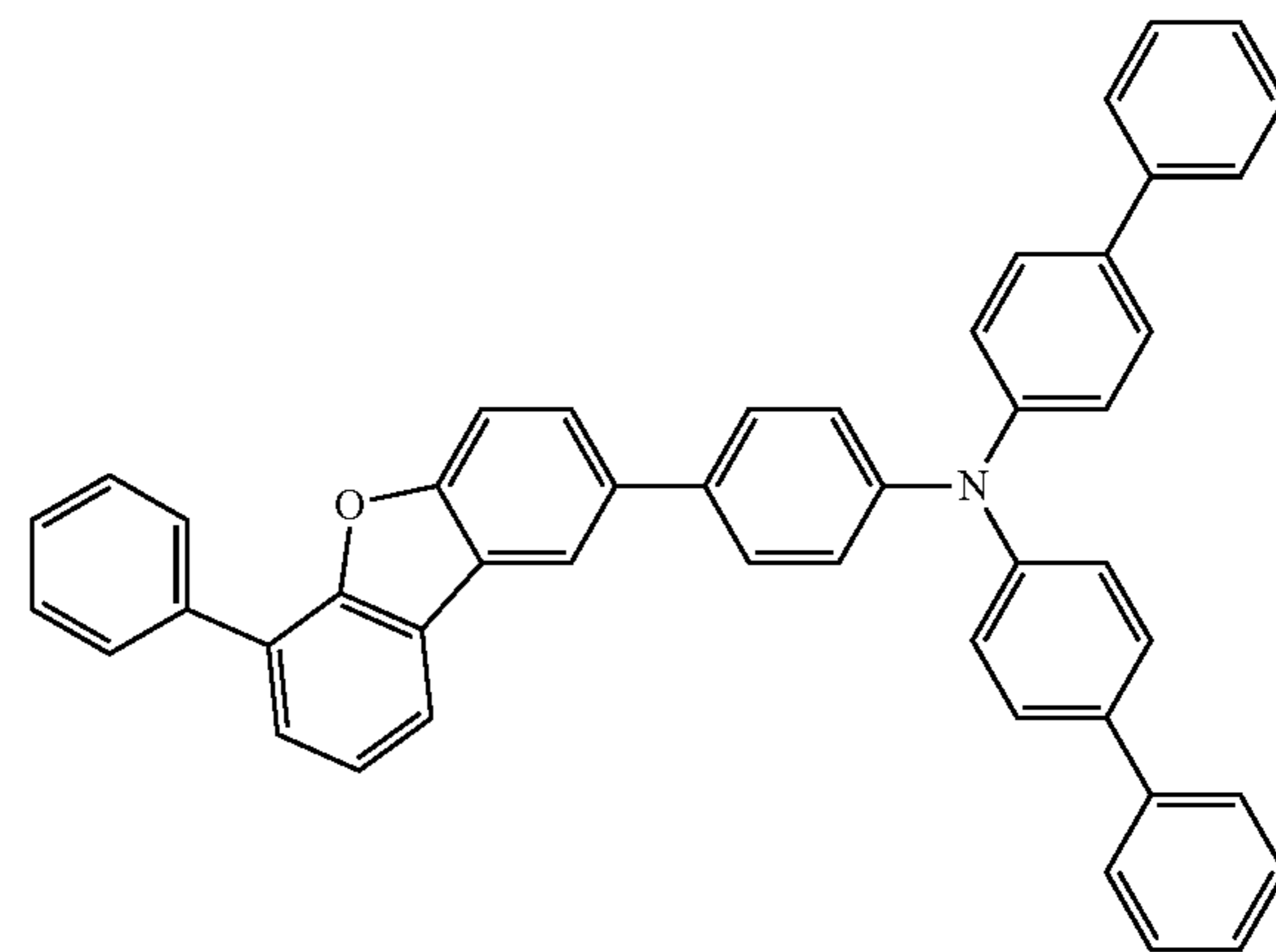


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1-76'

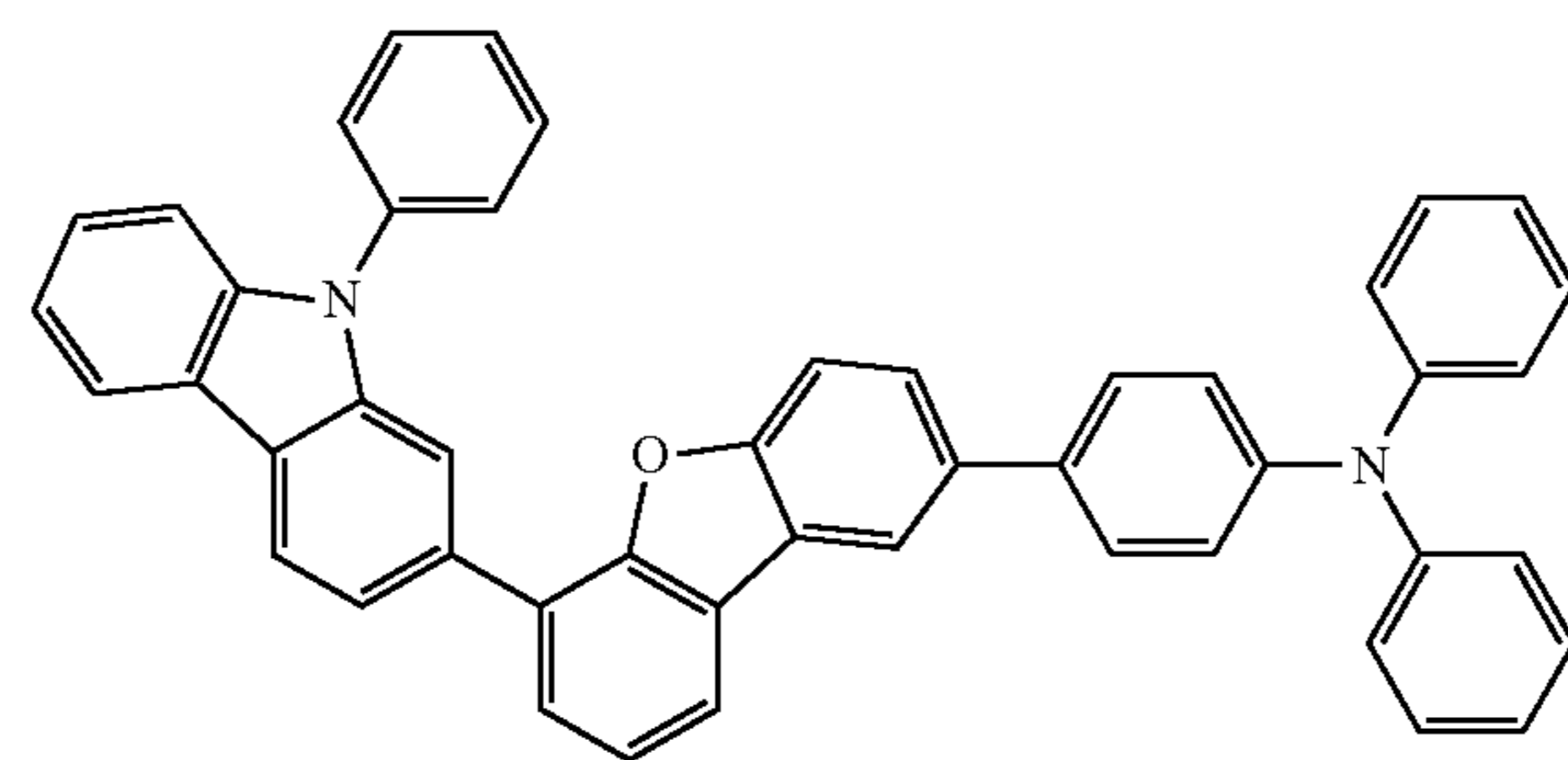


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1-77'

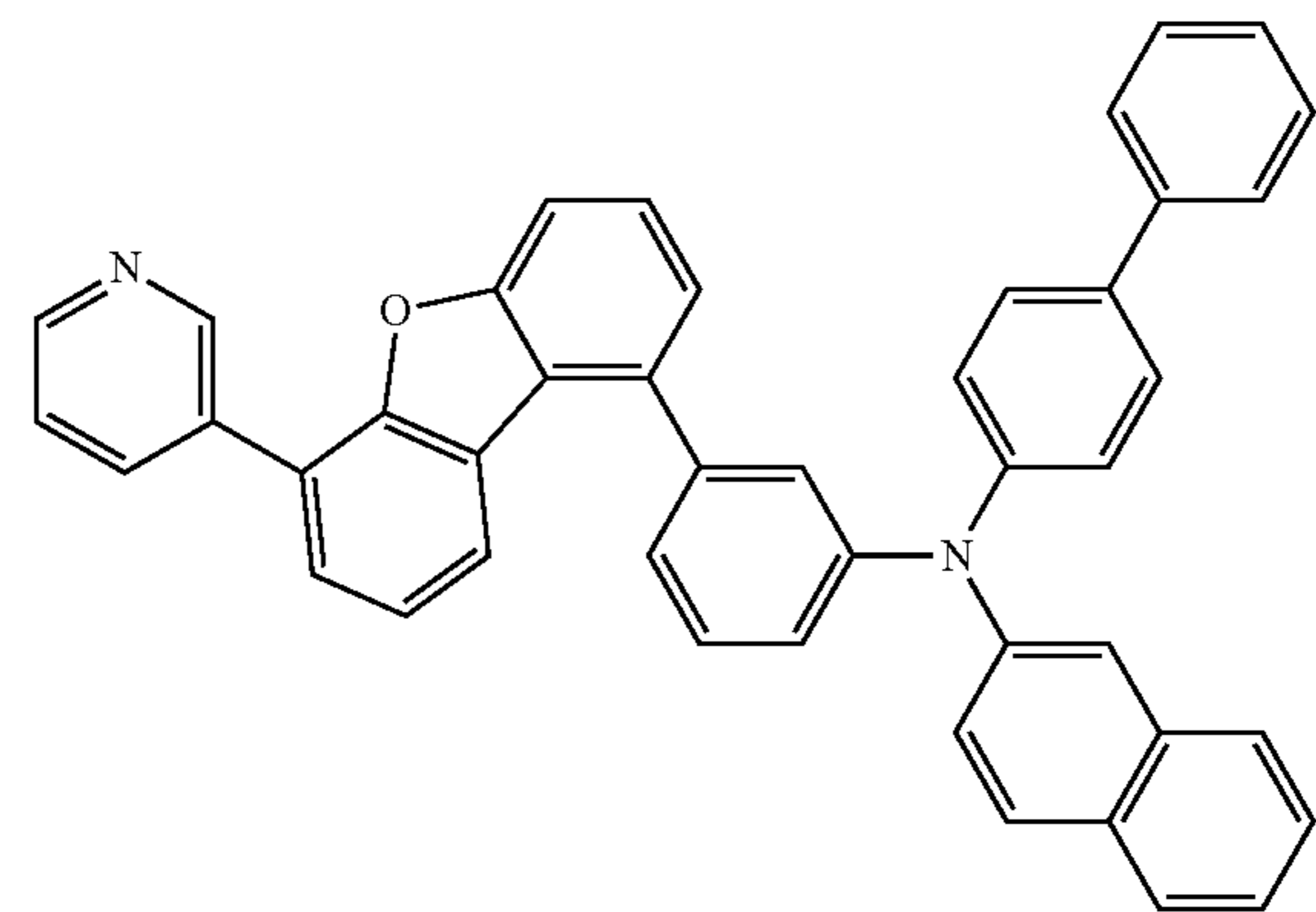


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1-78'



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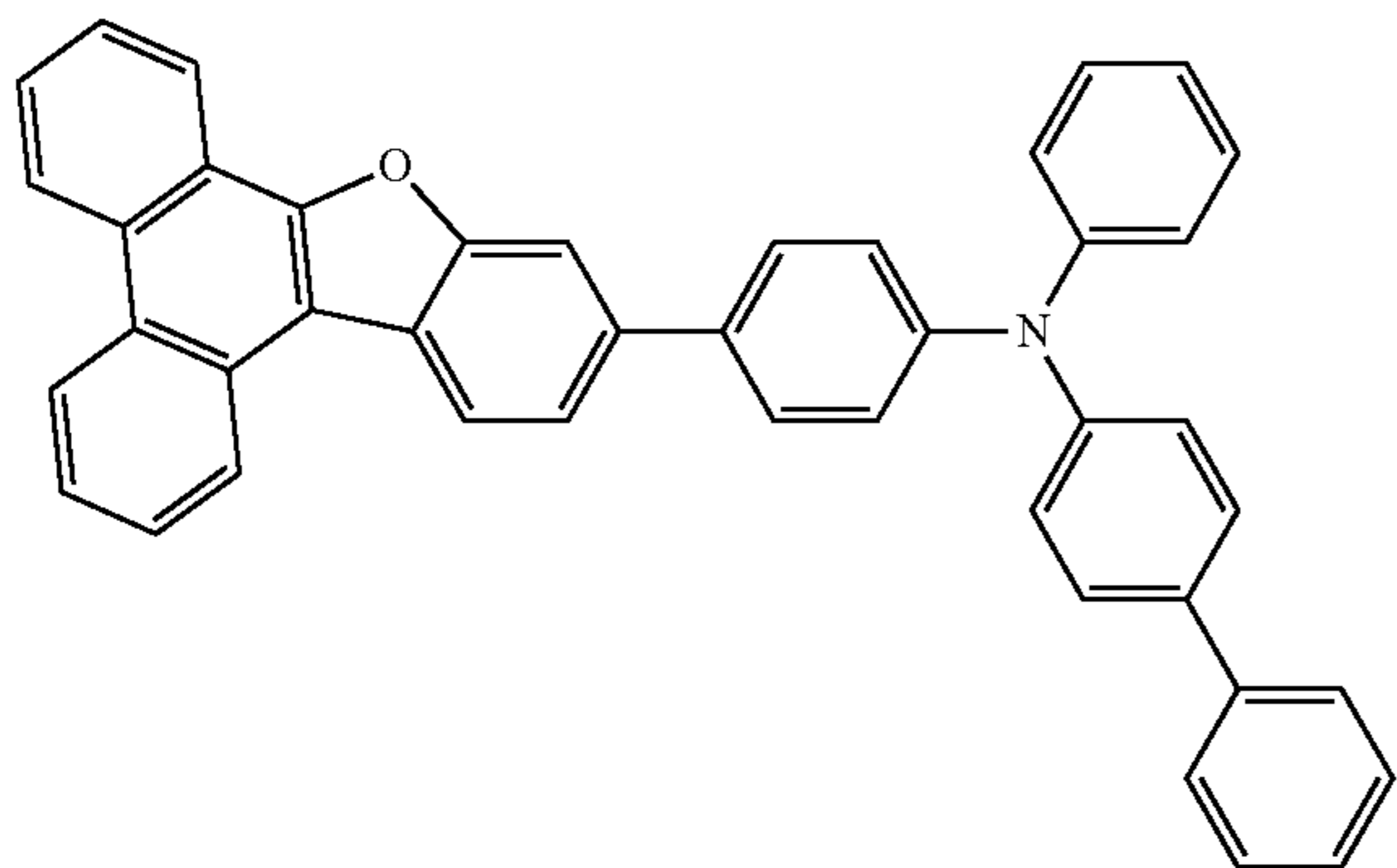
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1-79'

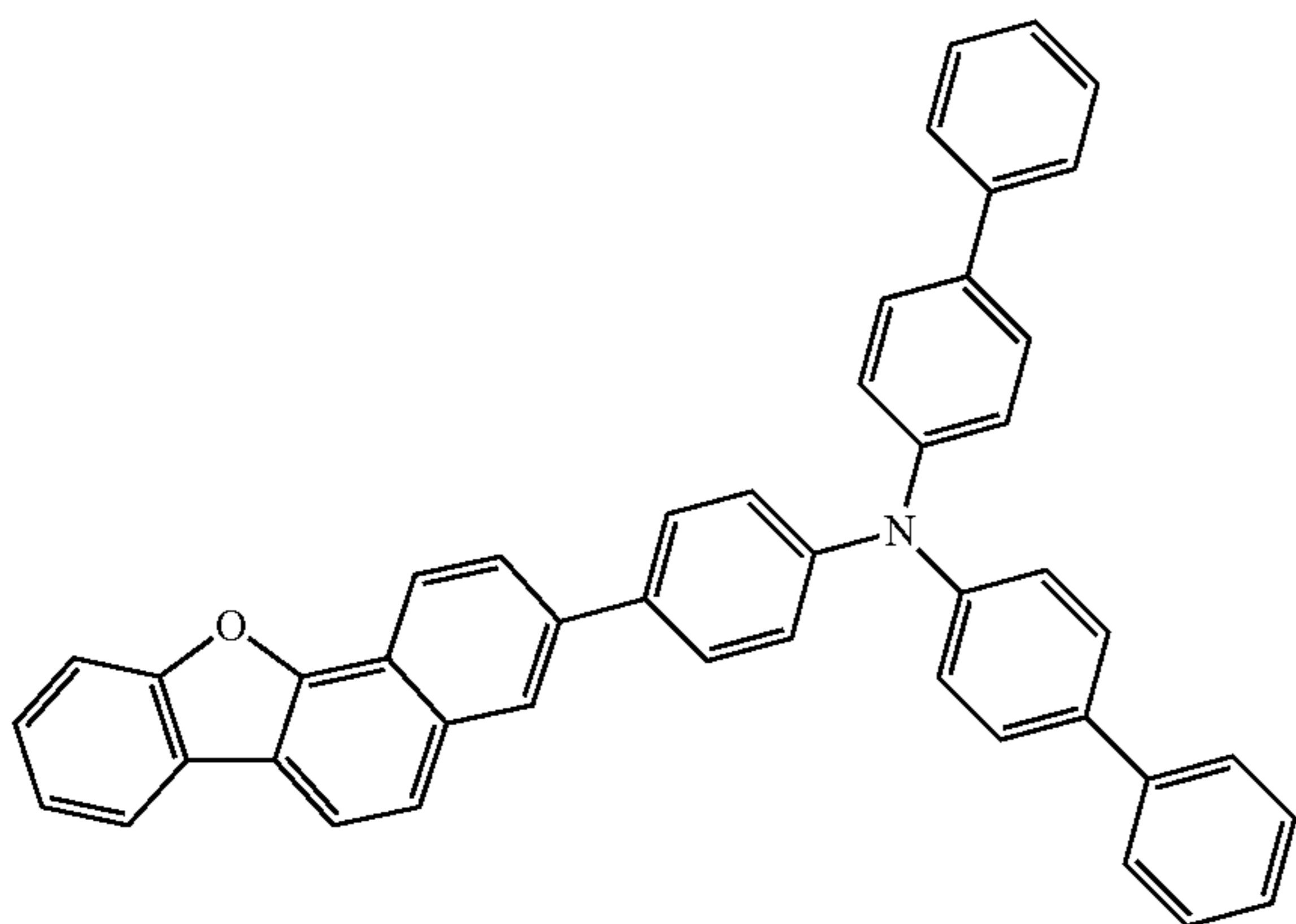


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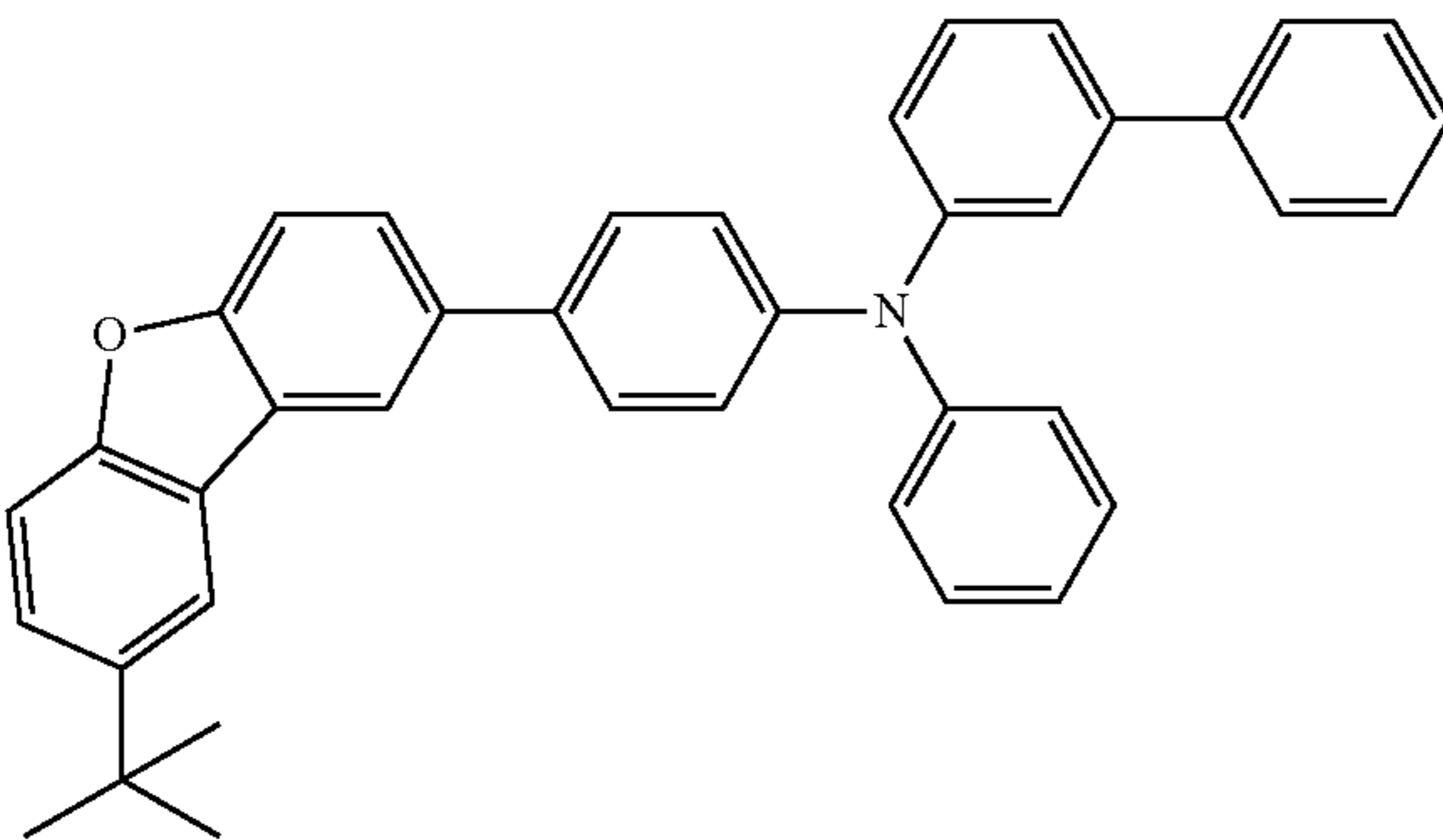


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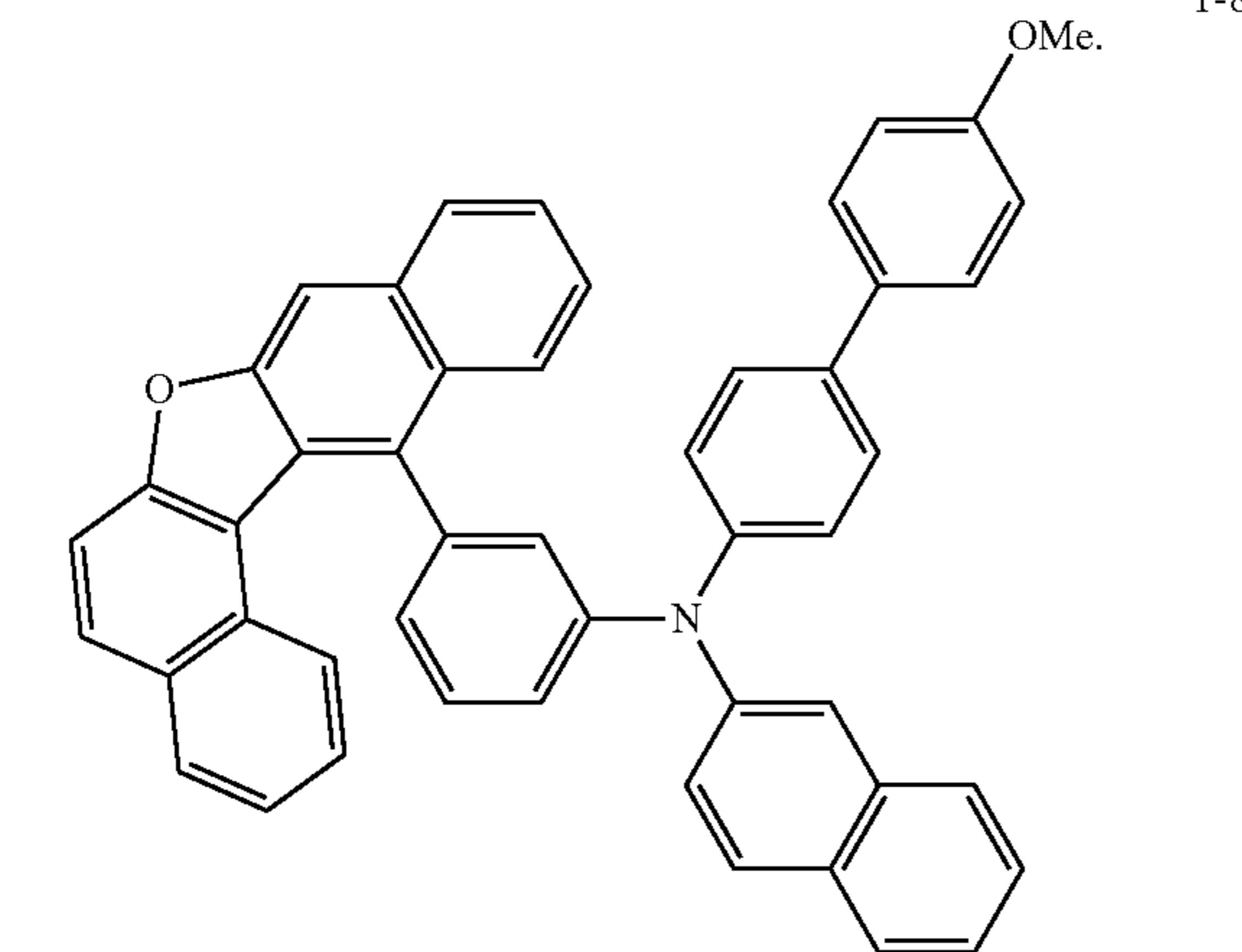


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1-82'



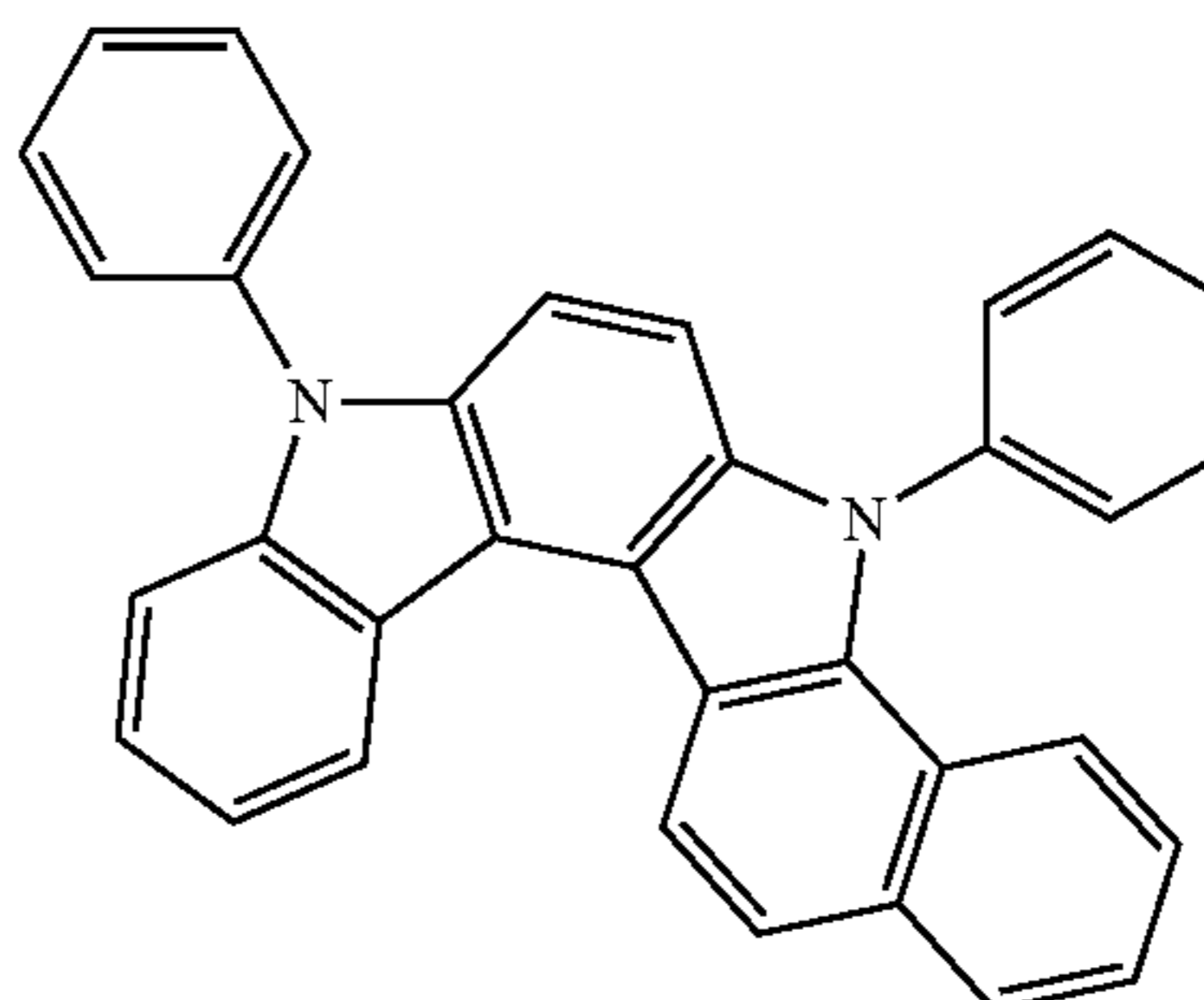
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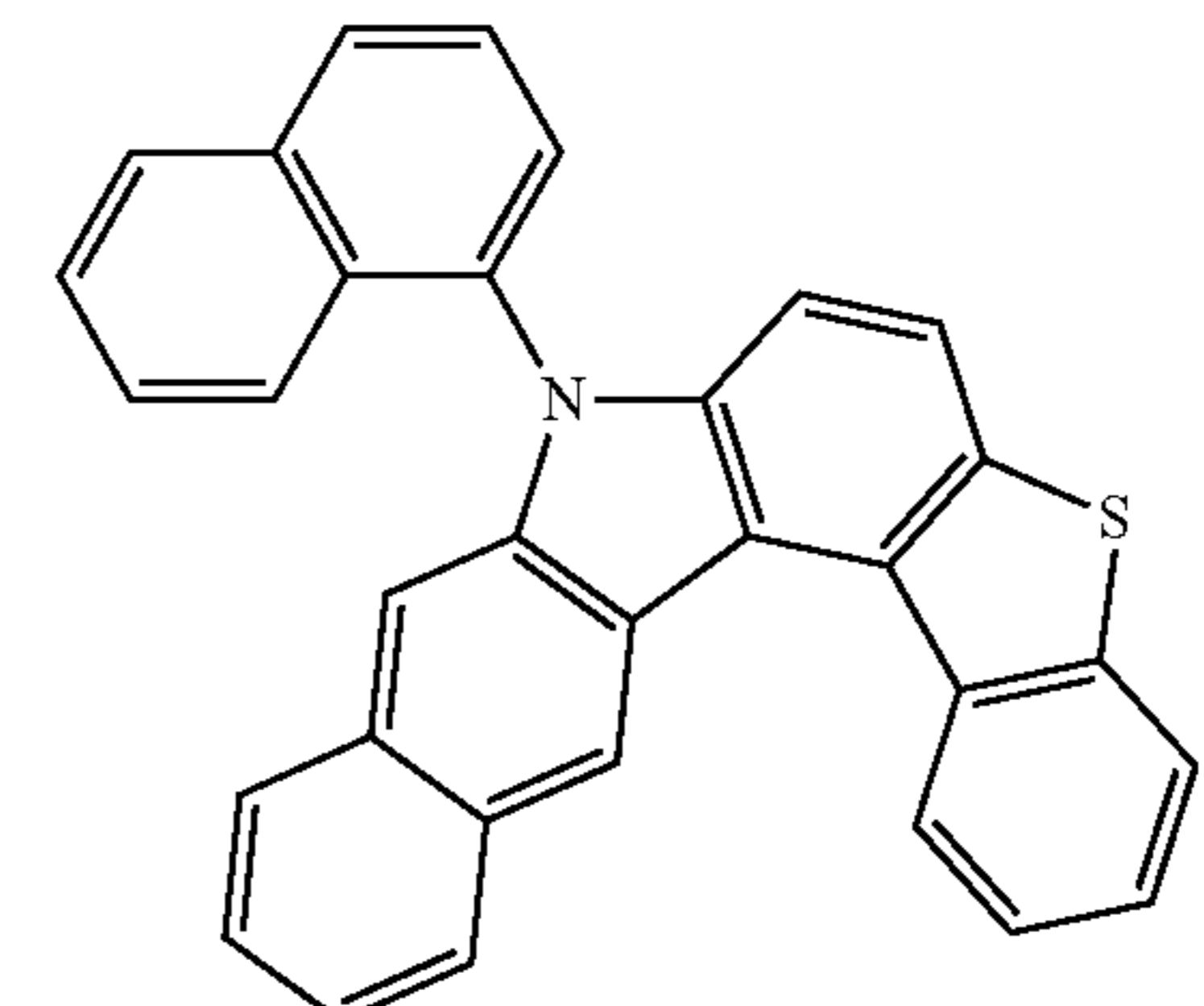
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214

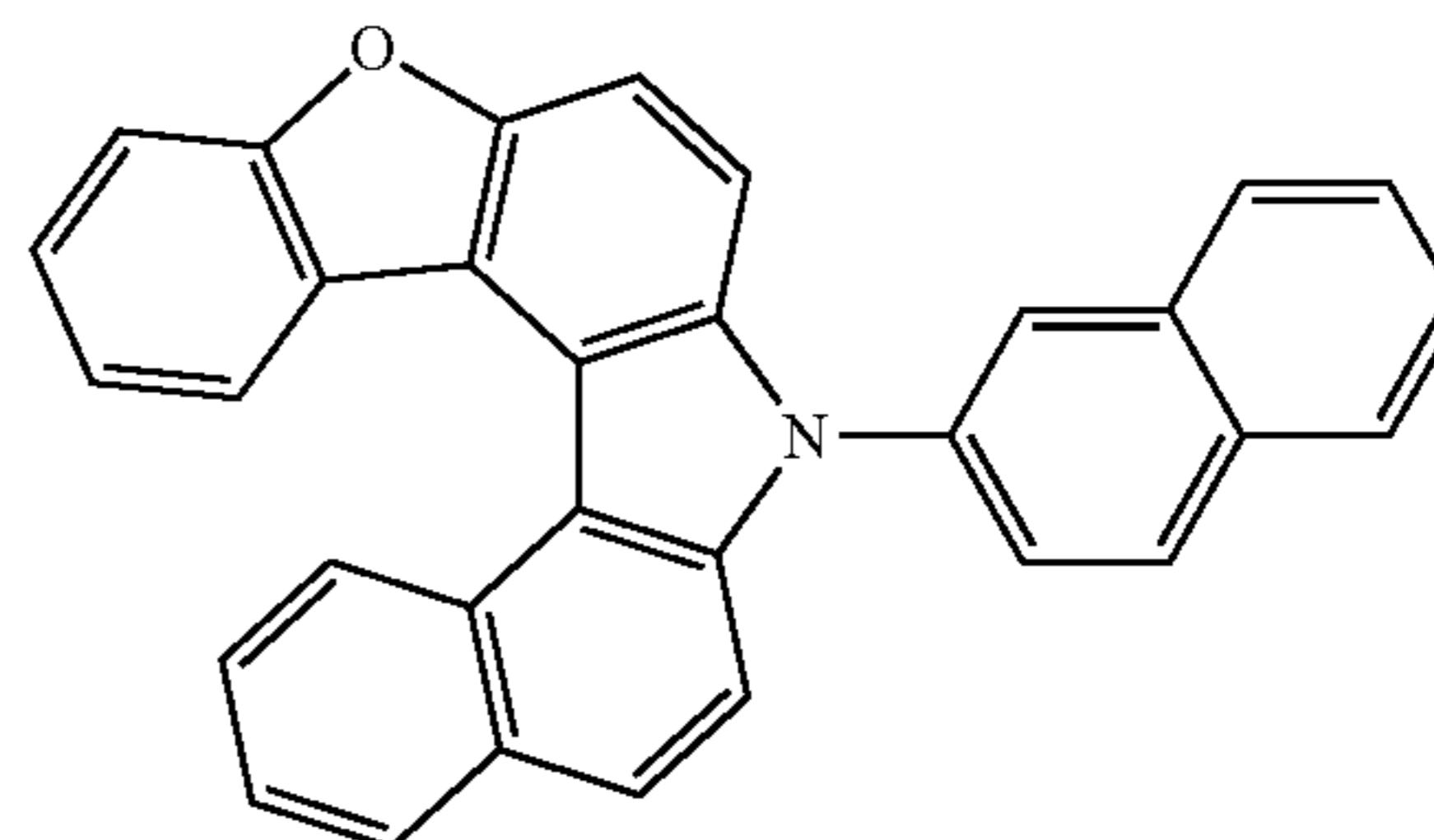
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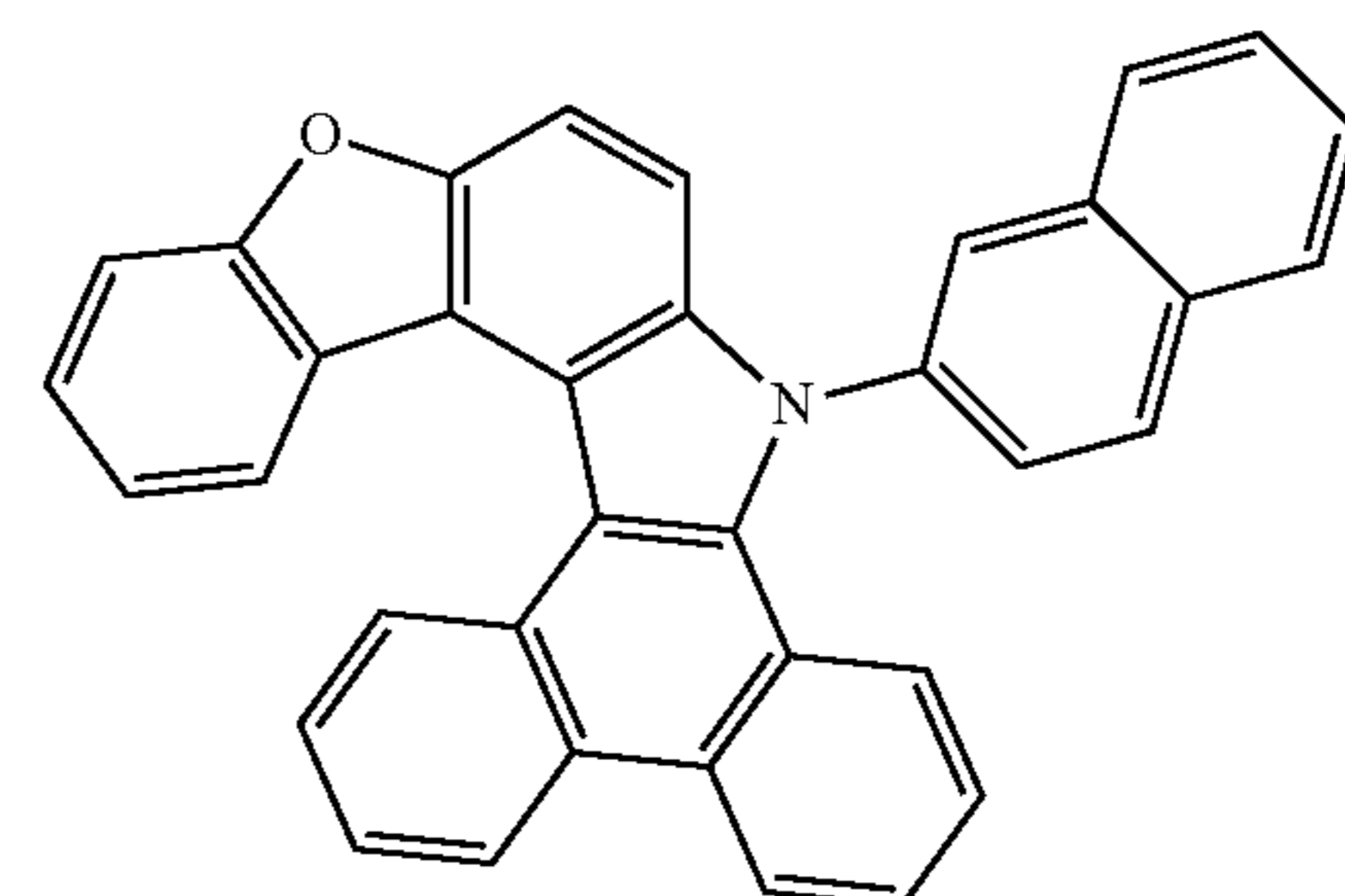
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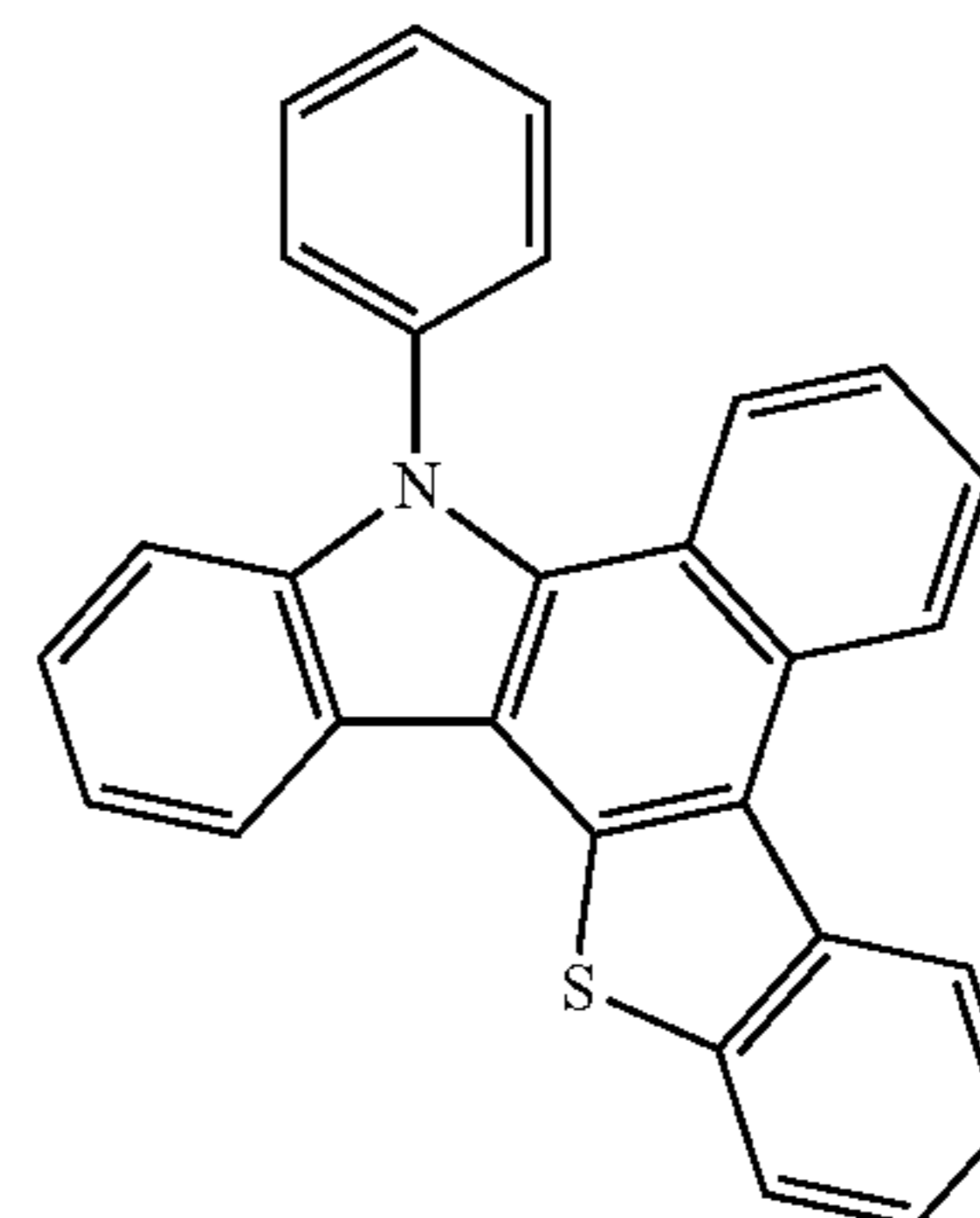
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3-4



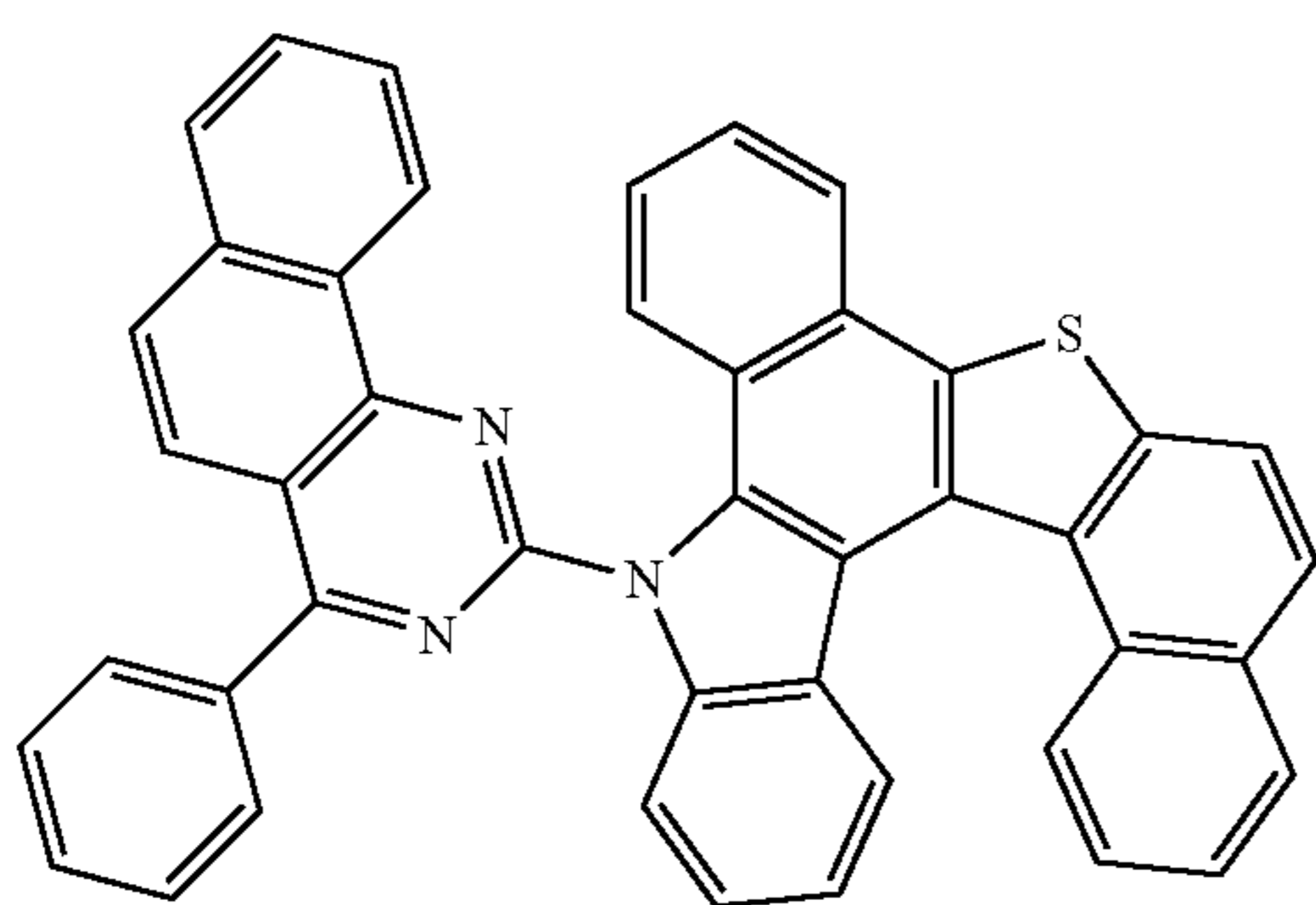
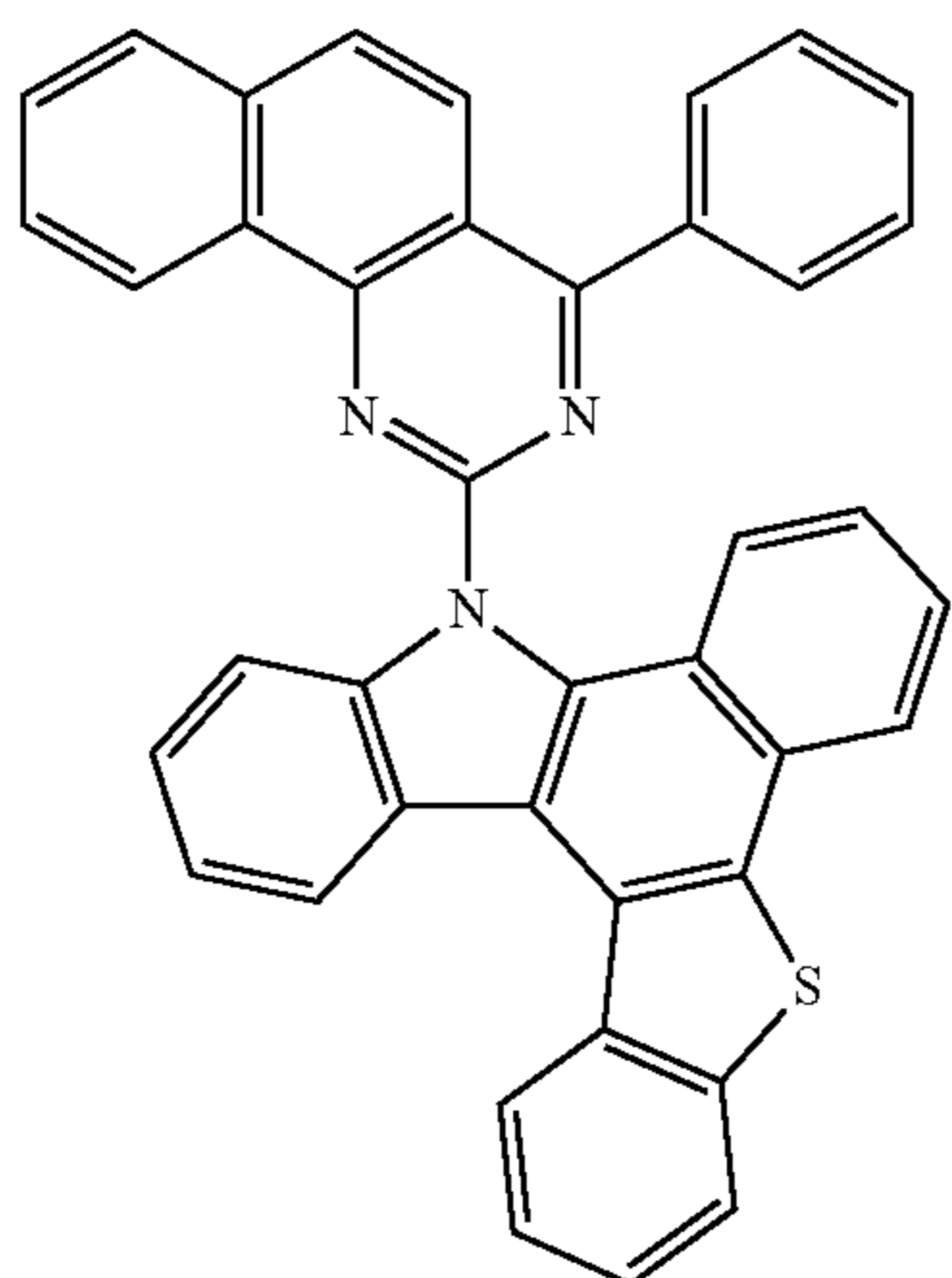
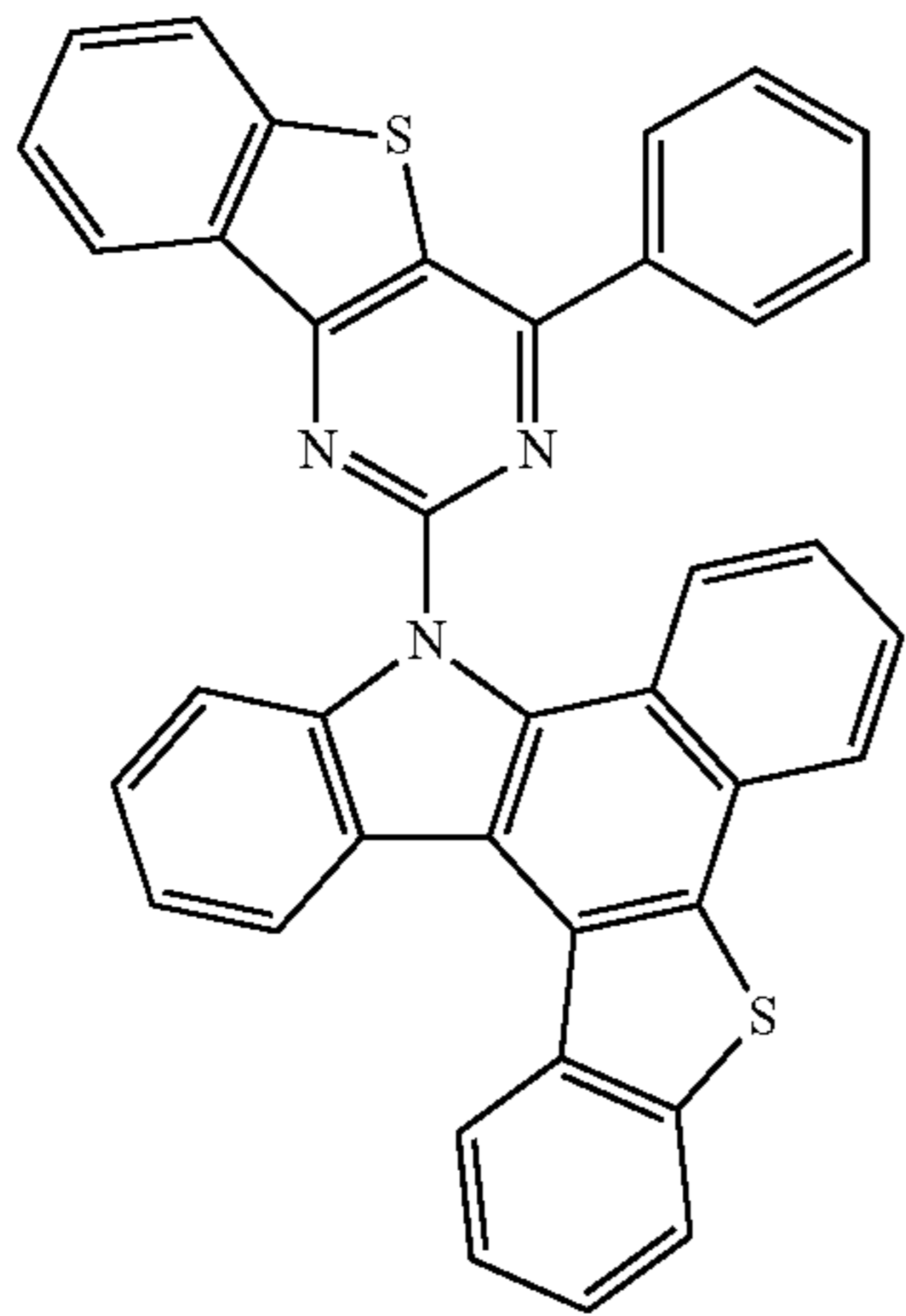
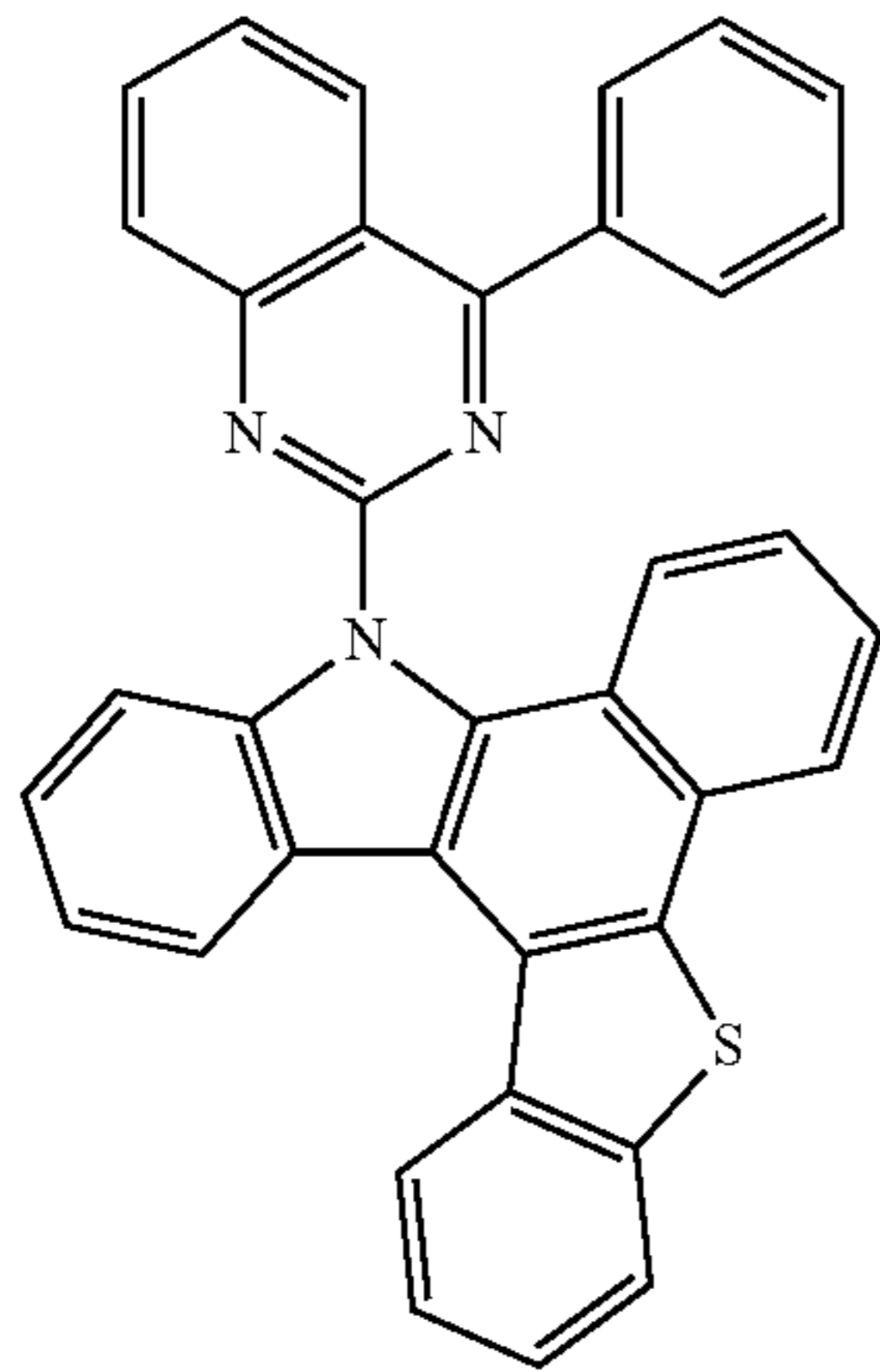
3-5



15. The organic electric element according to claim 1, wherein the second host compound represented by Formula (2) is one of the following compounds 3-1 to 3-100:

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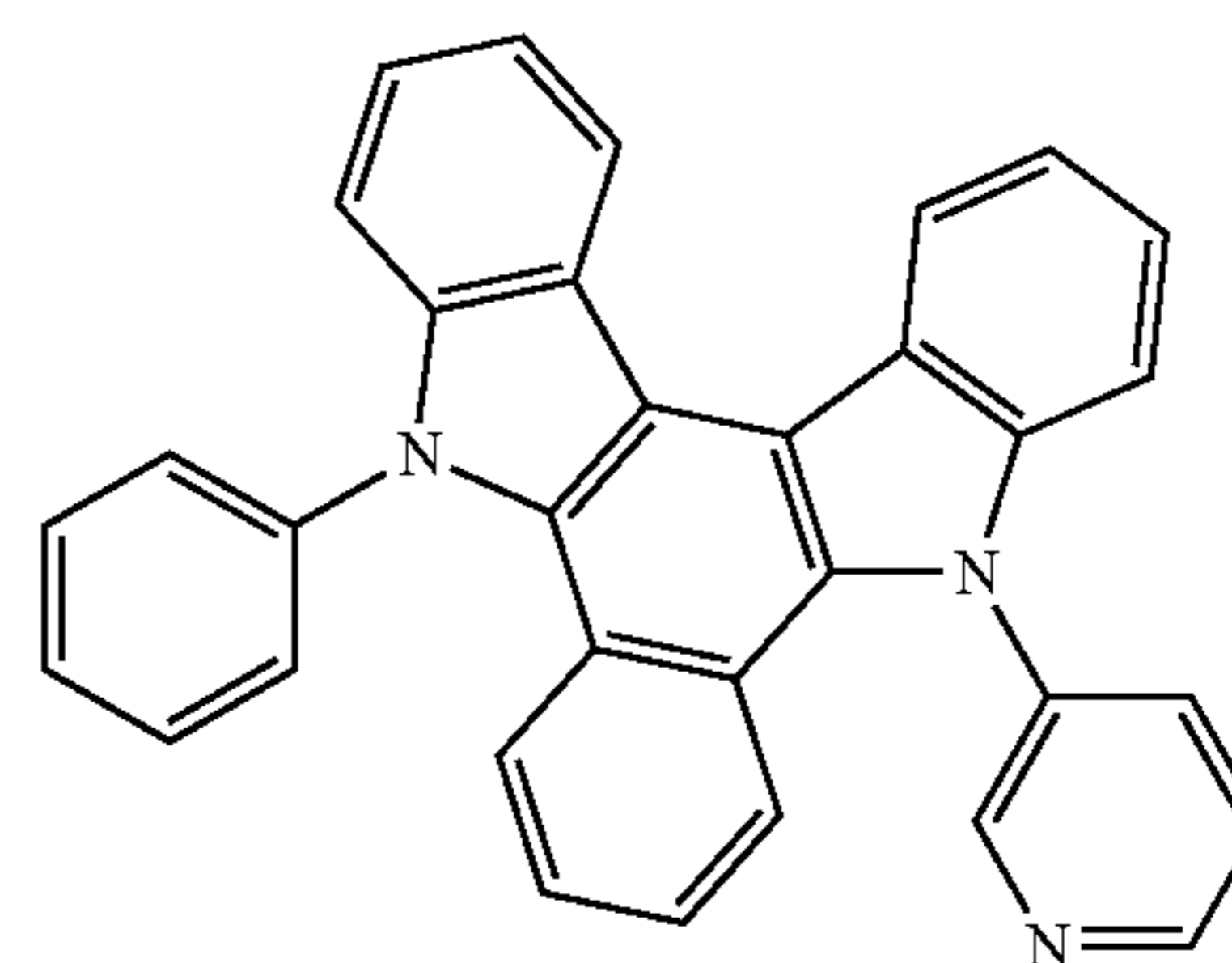
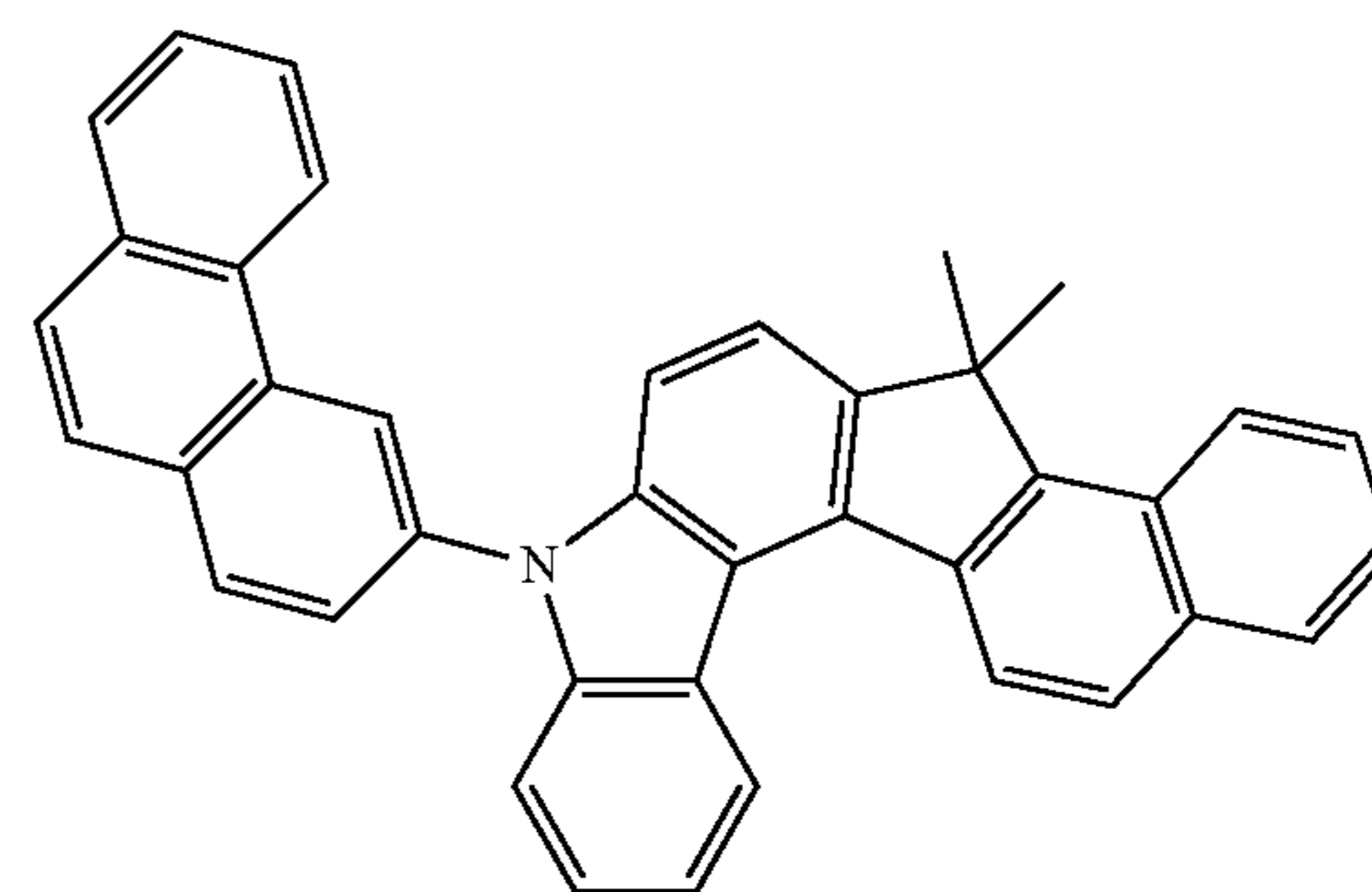
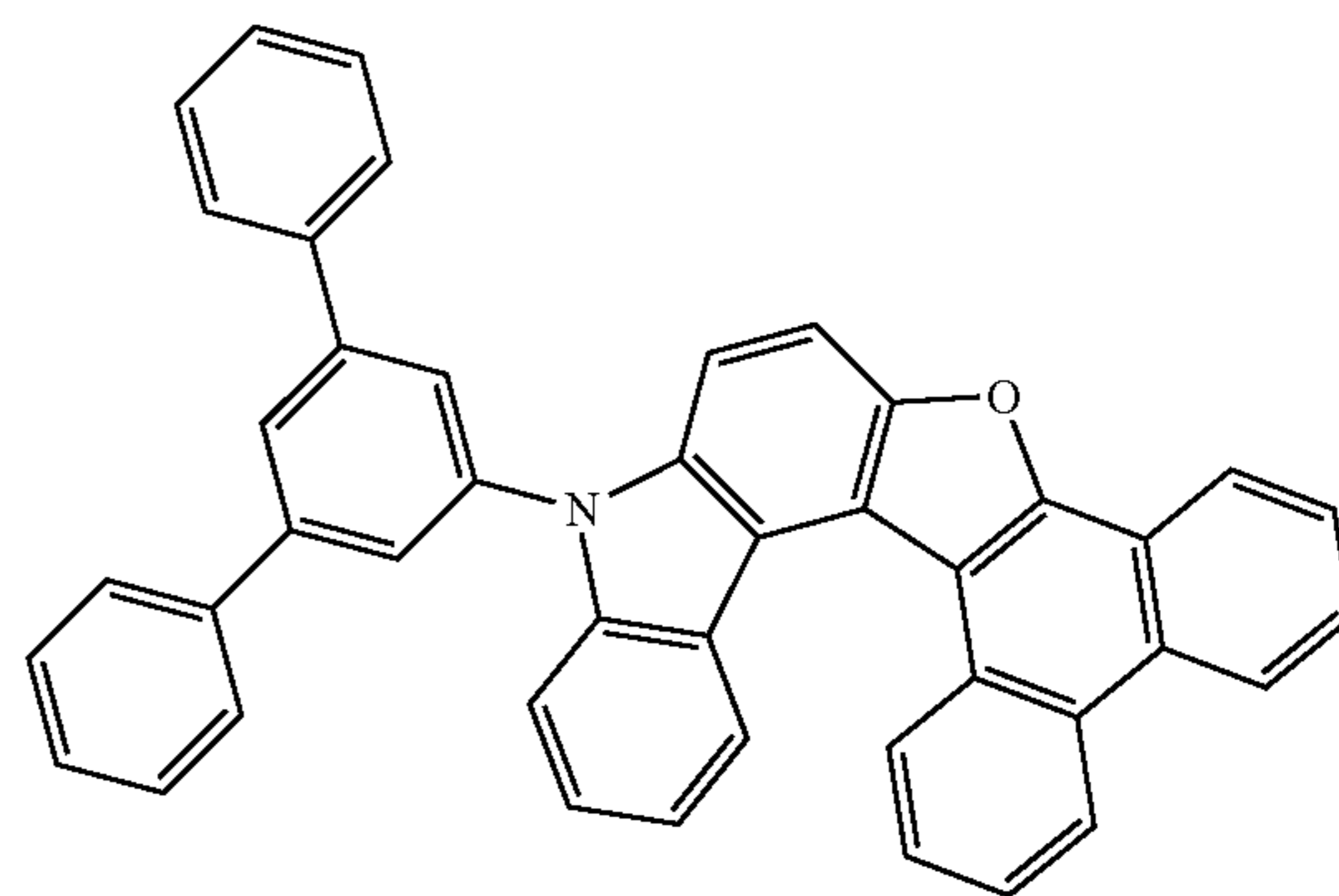
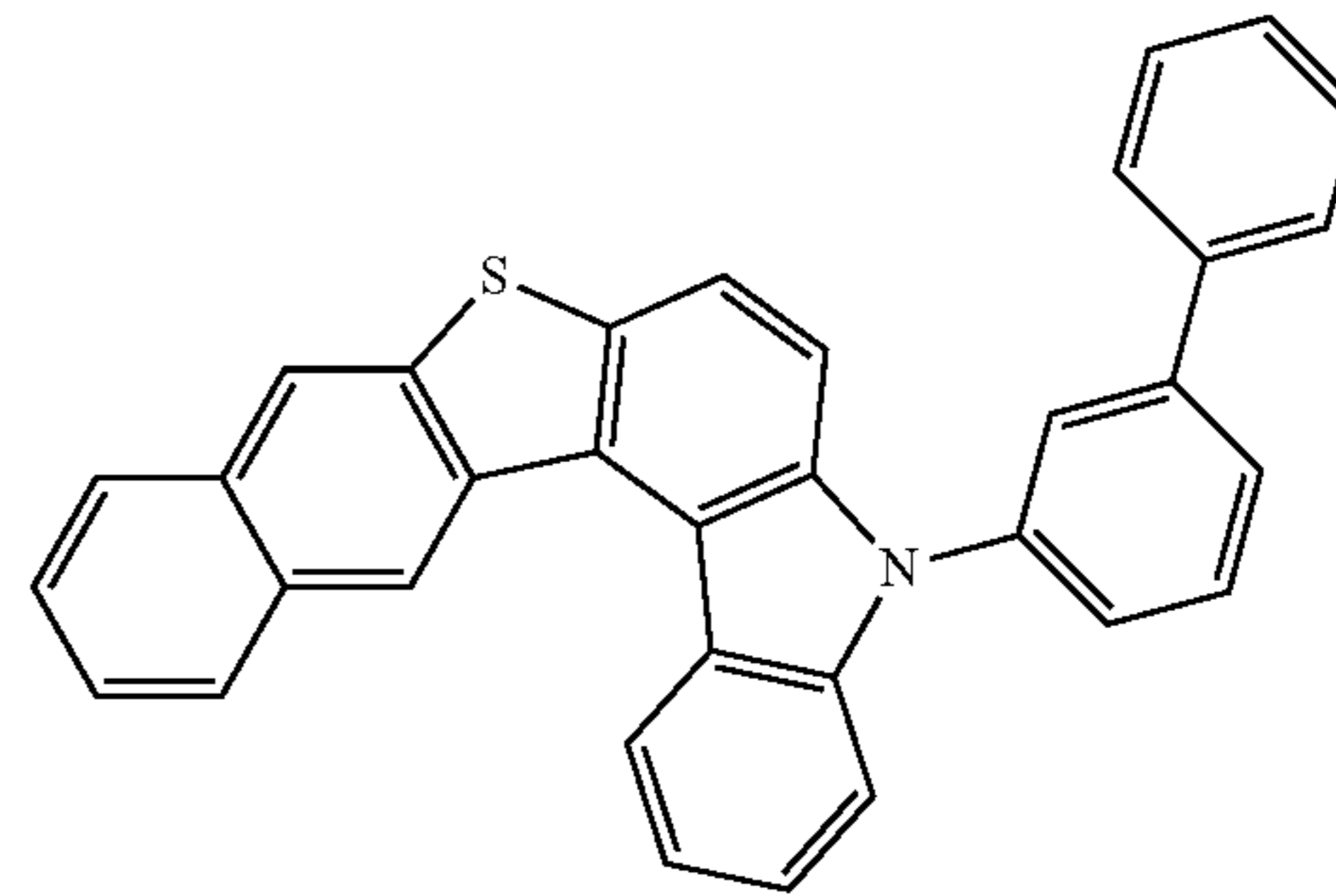
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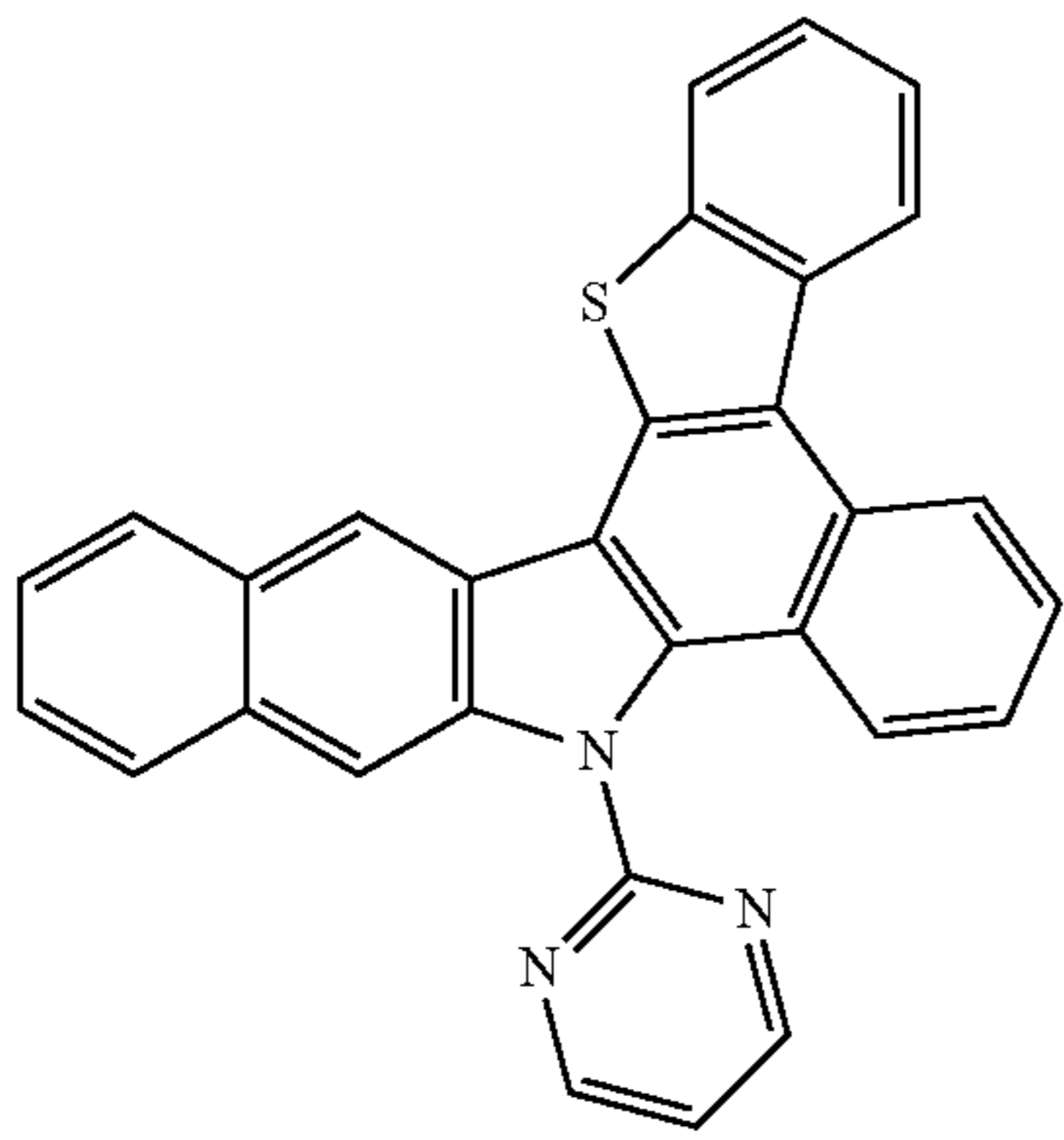
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3-10

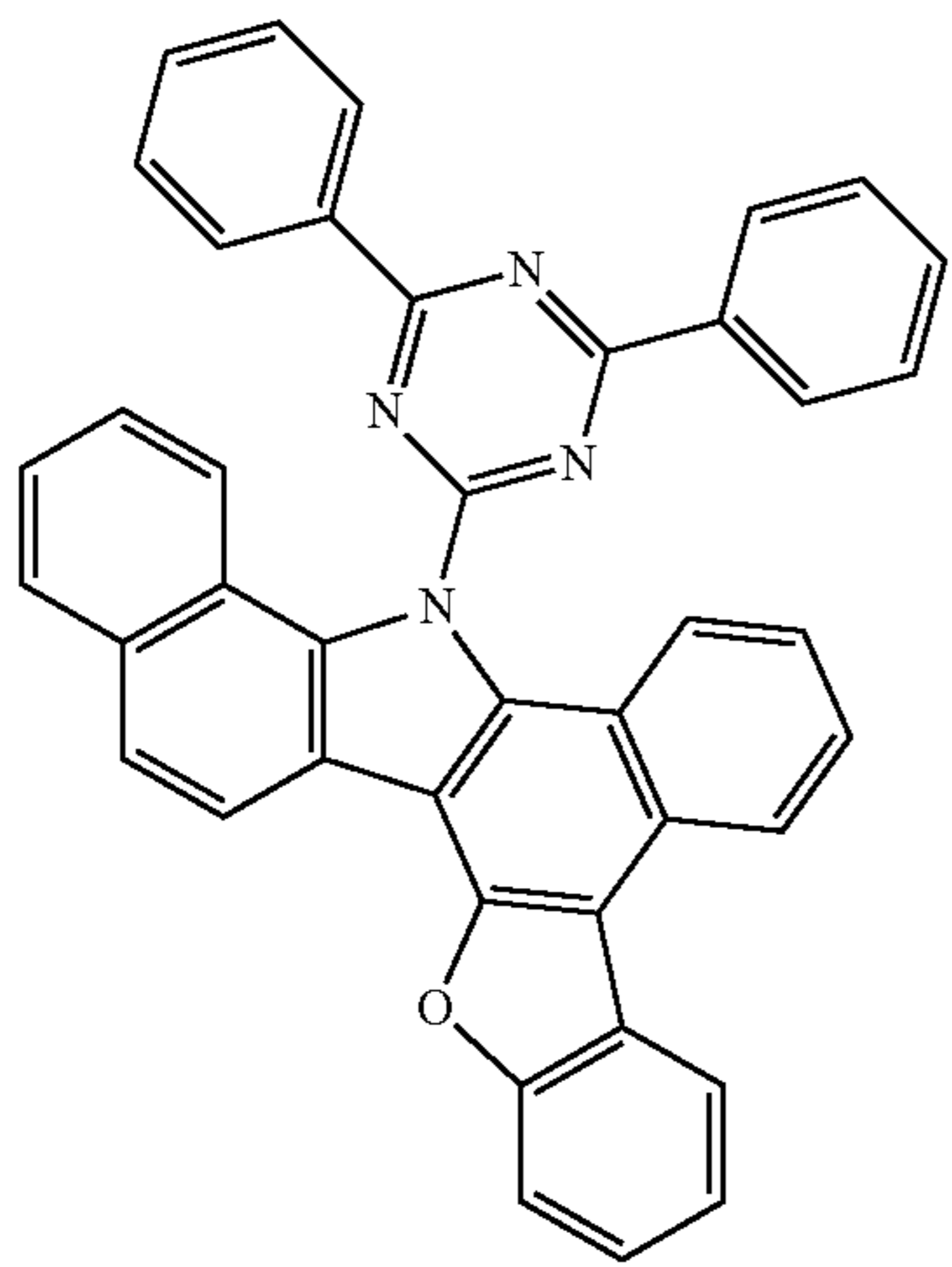


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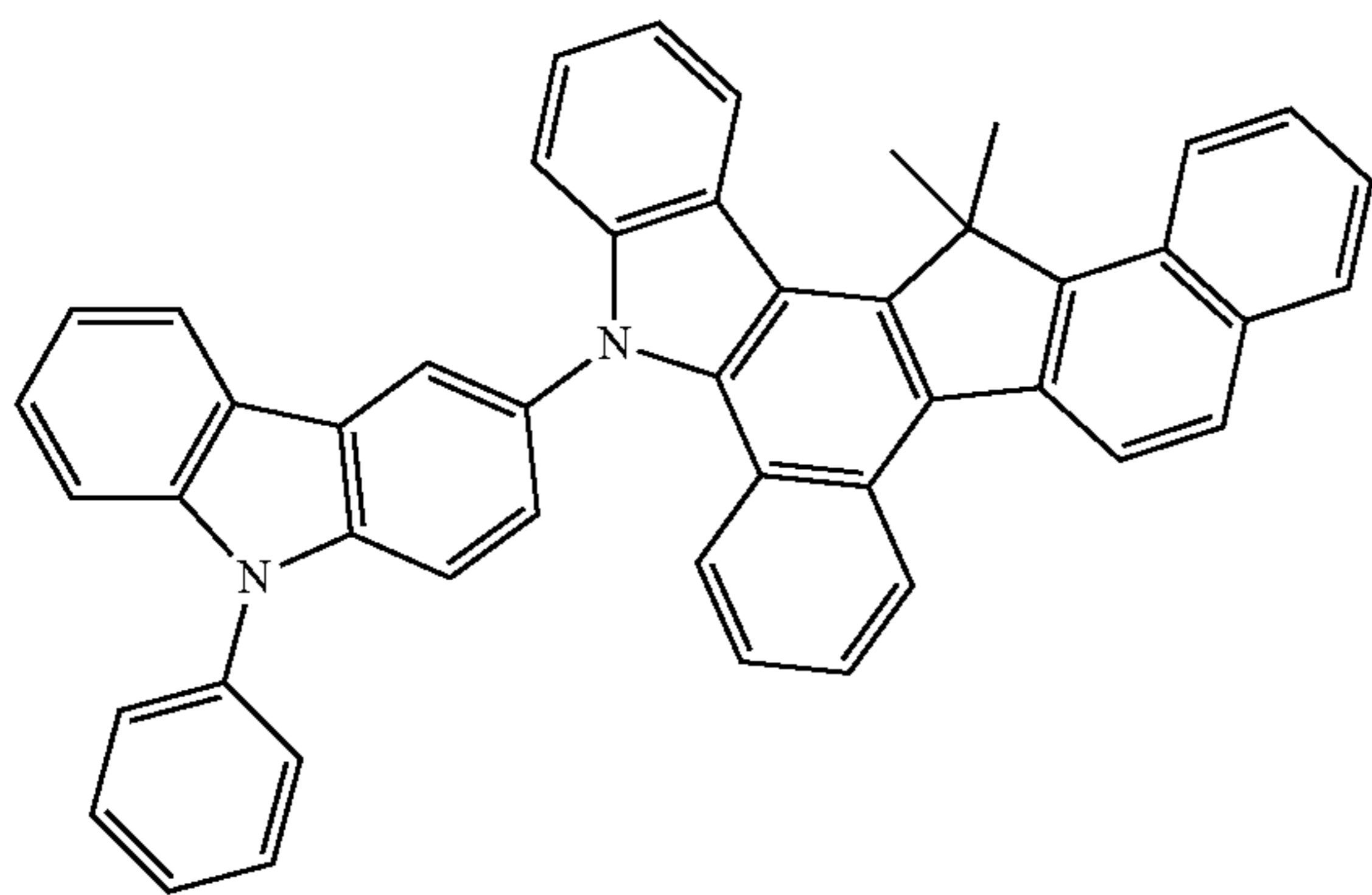
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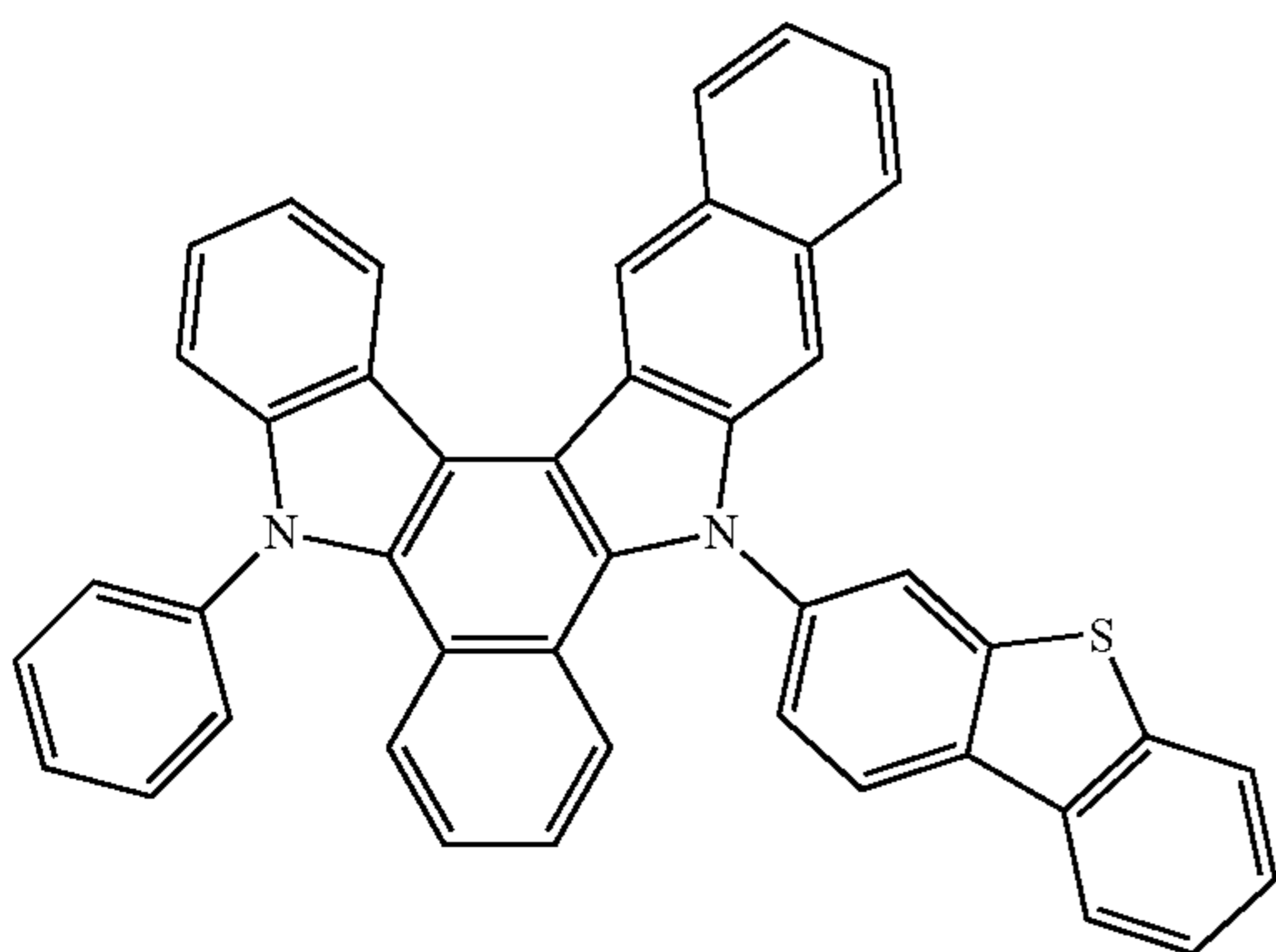
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3-15



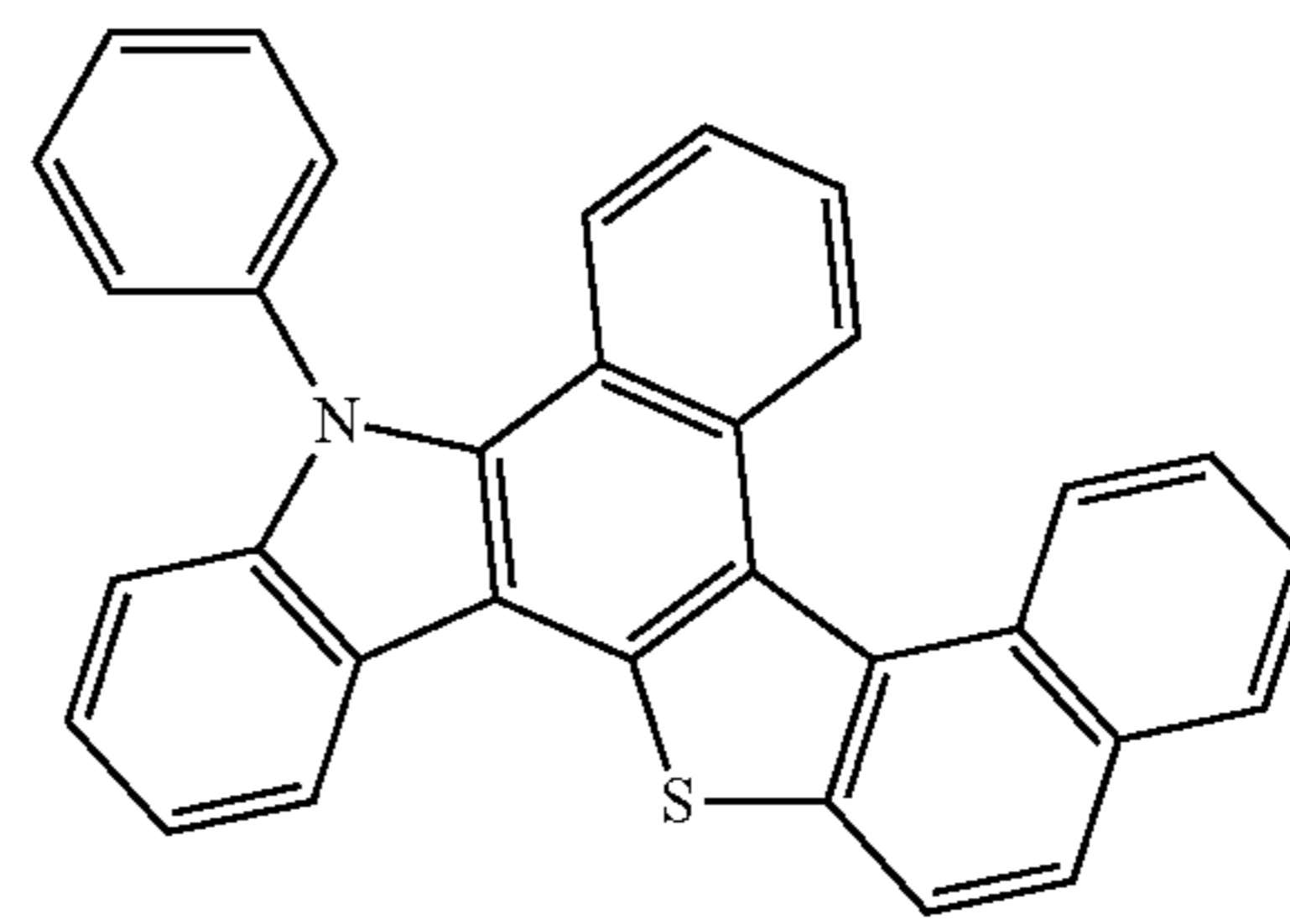
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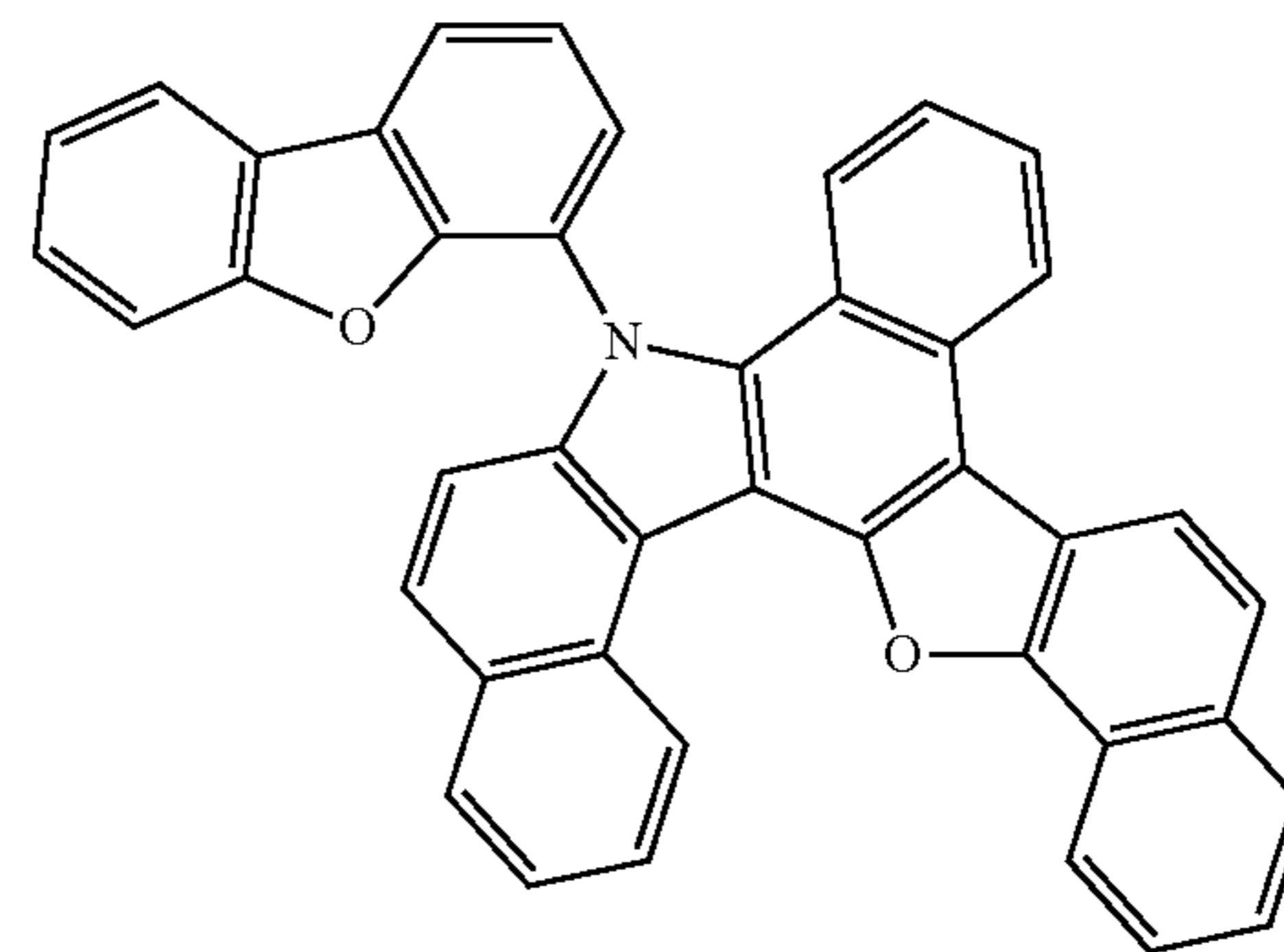
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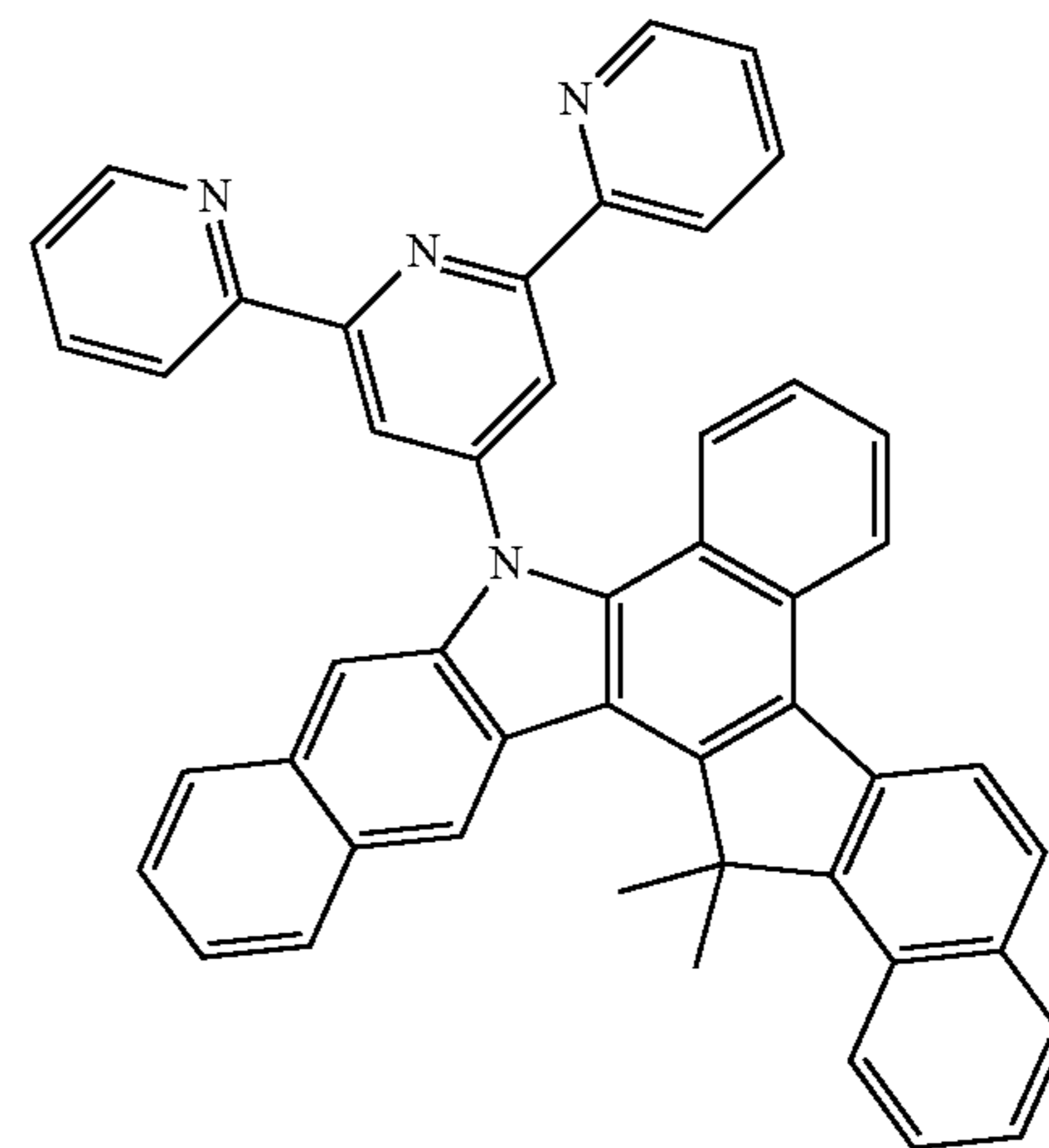
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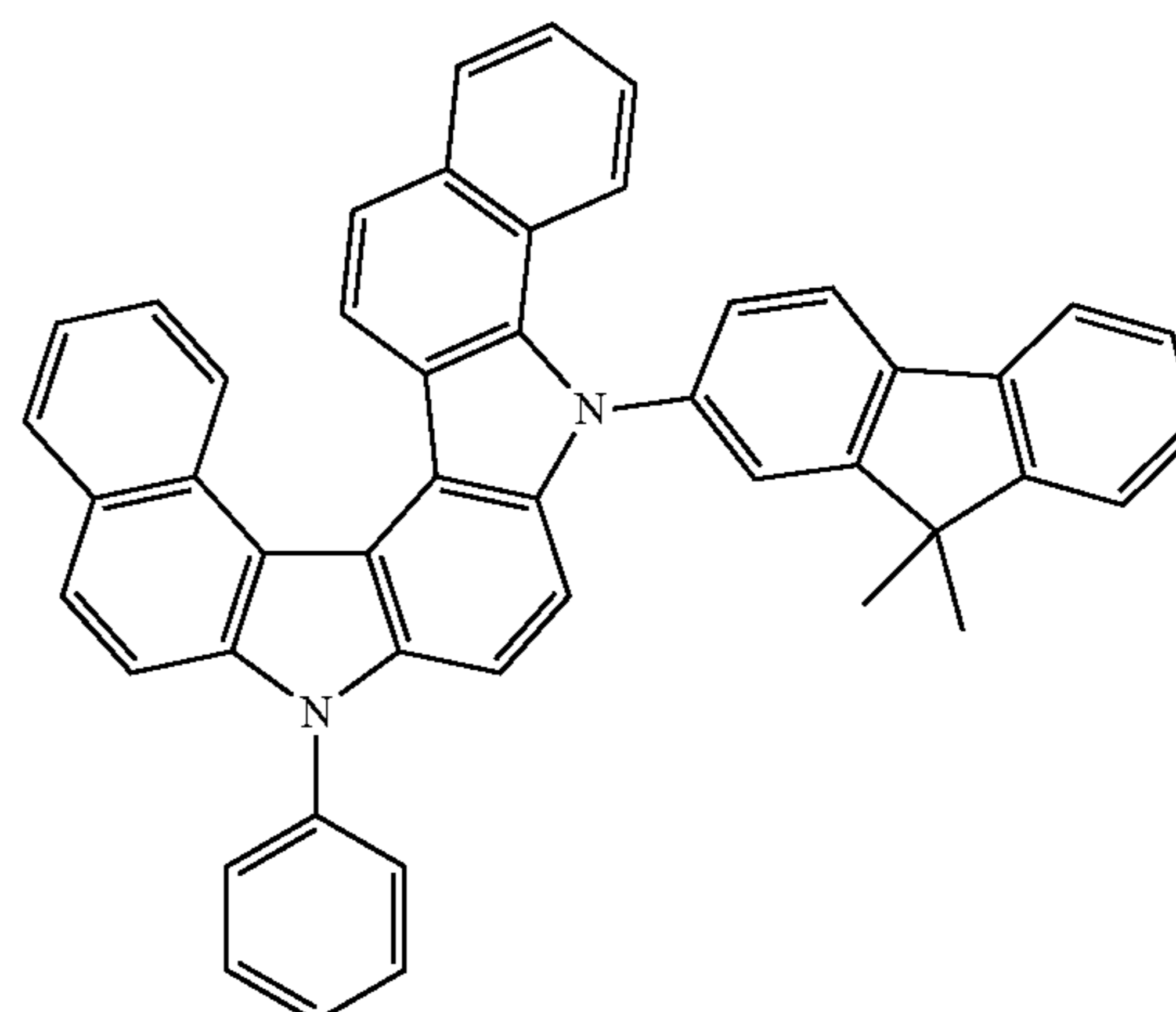
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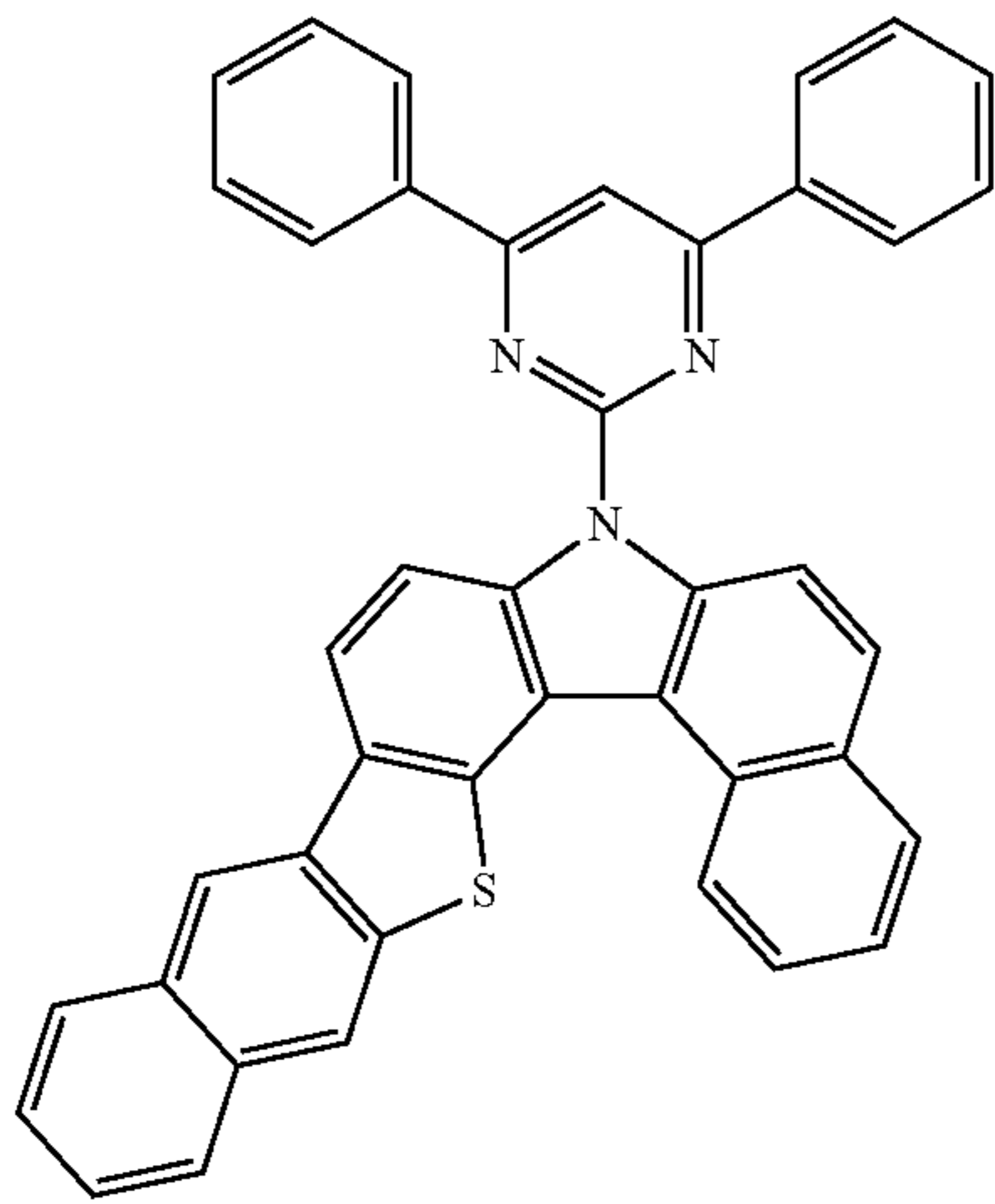
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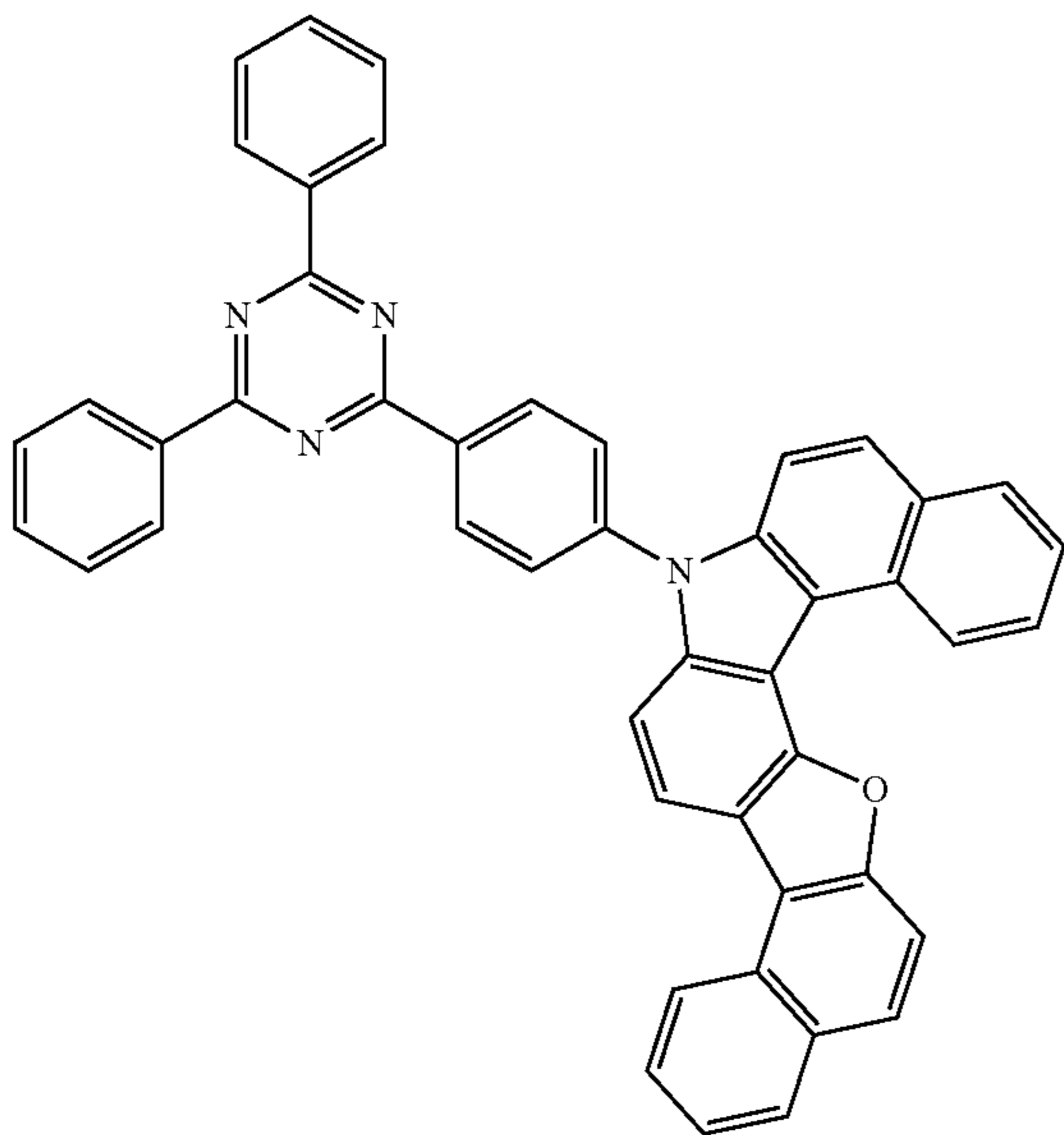
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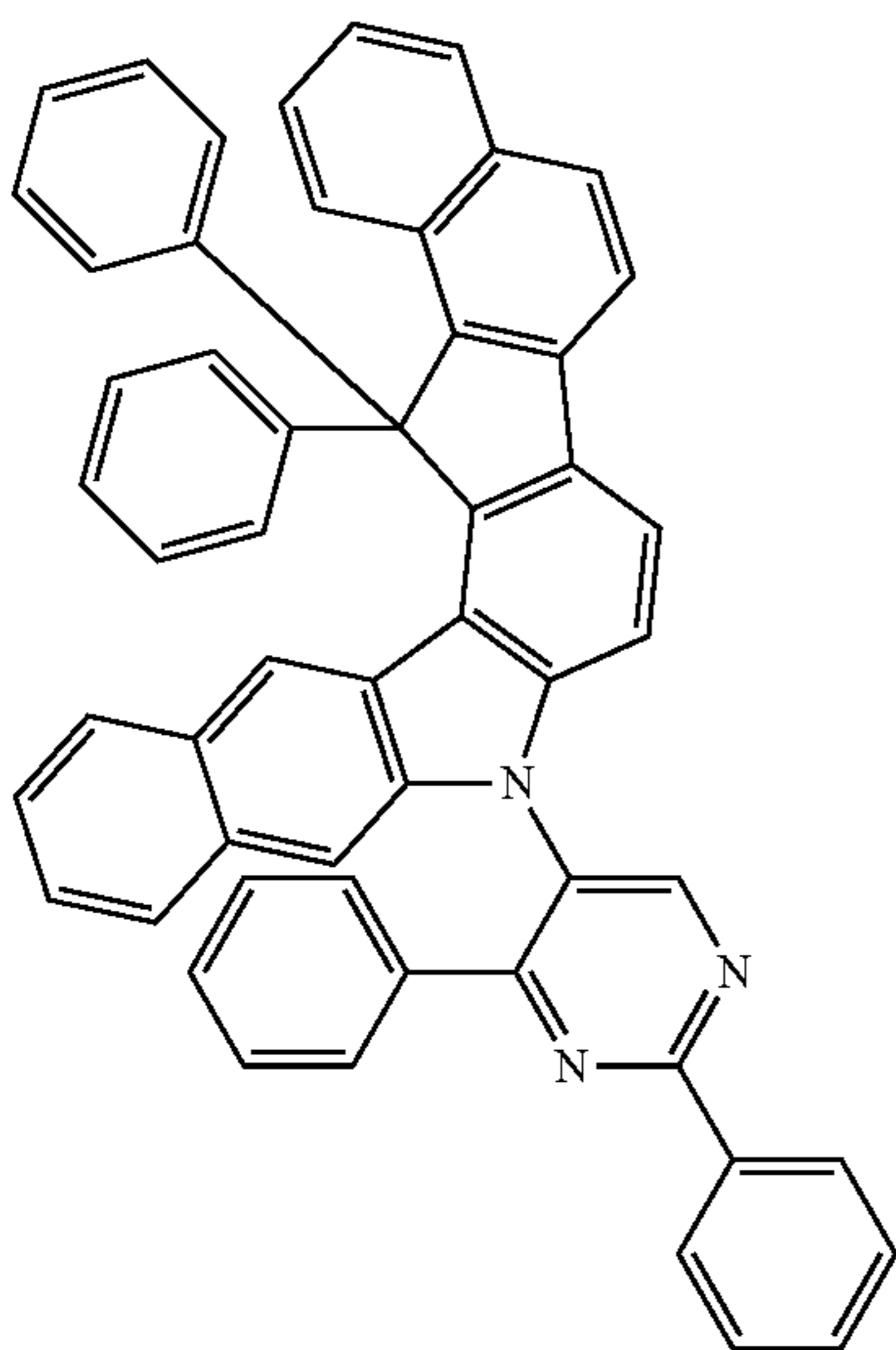
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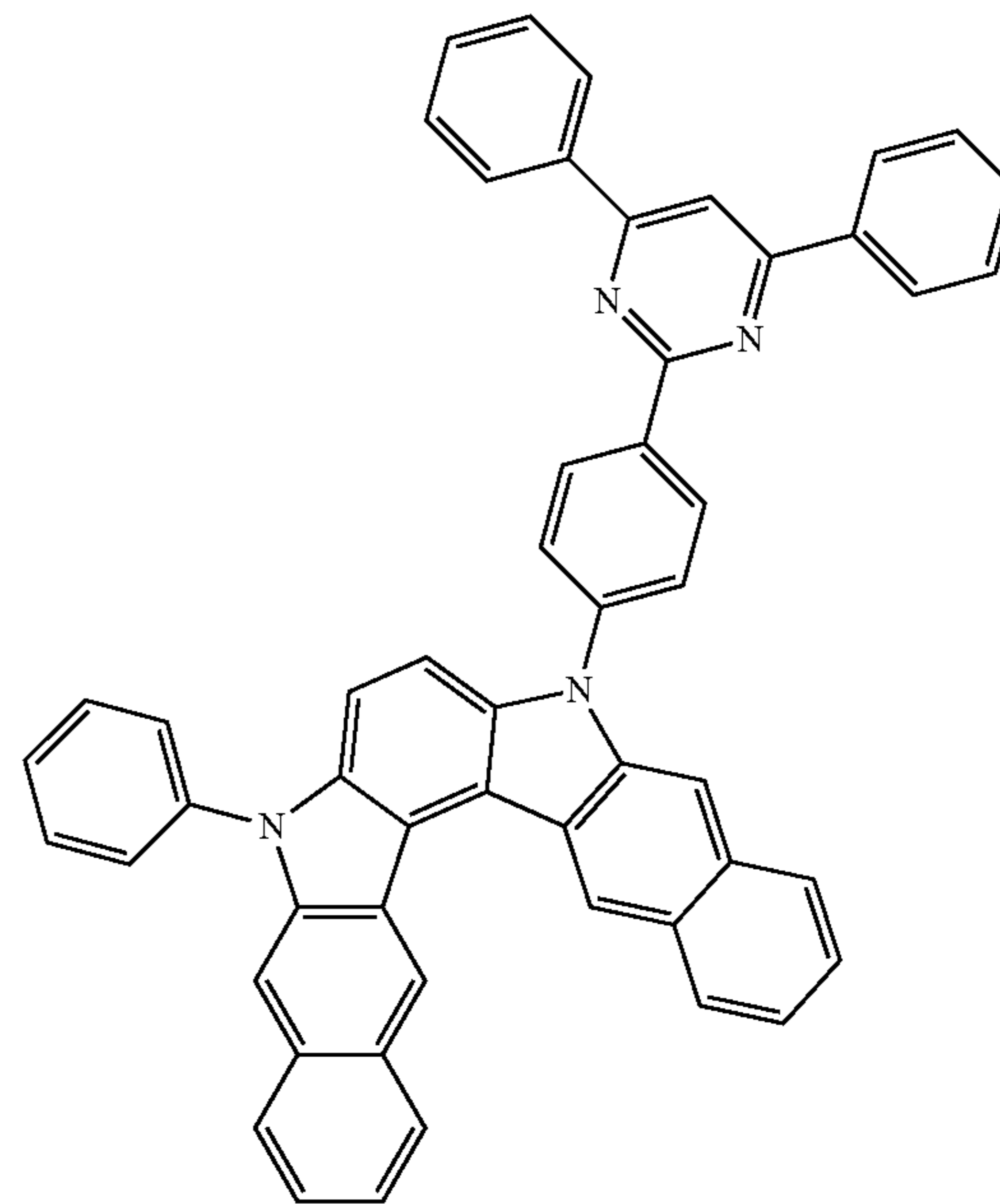
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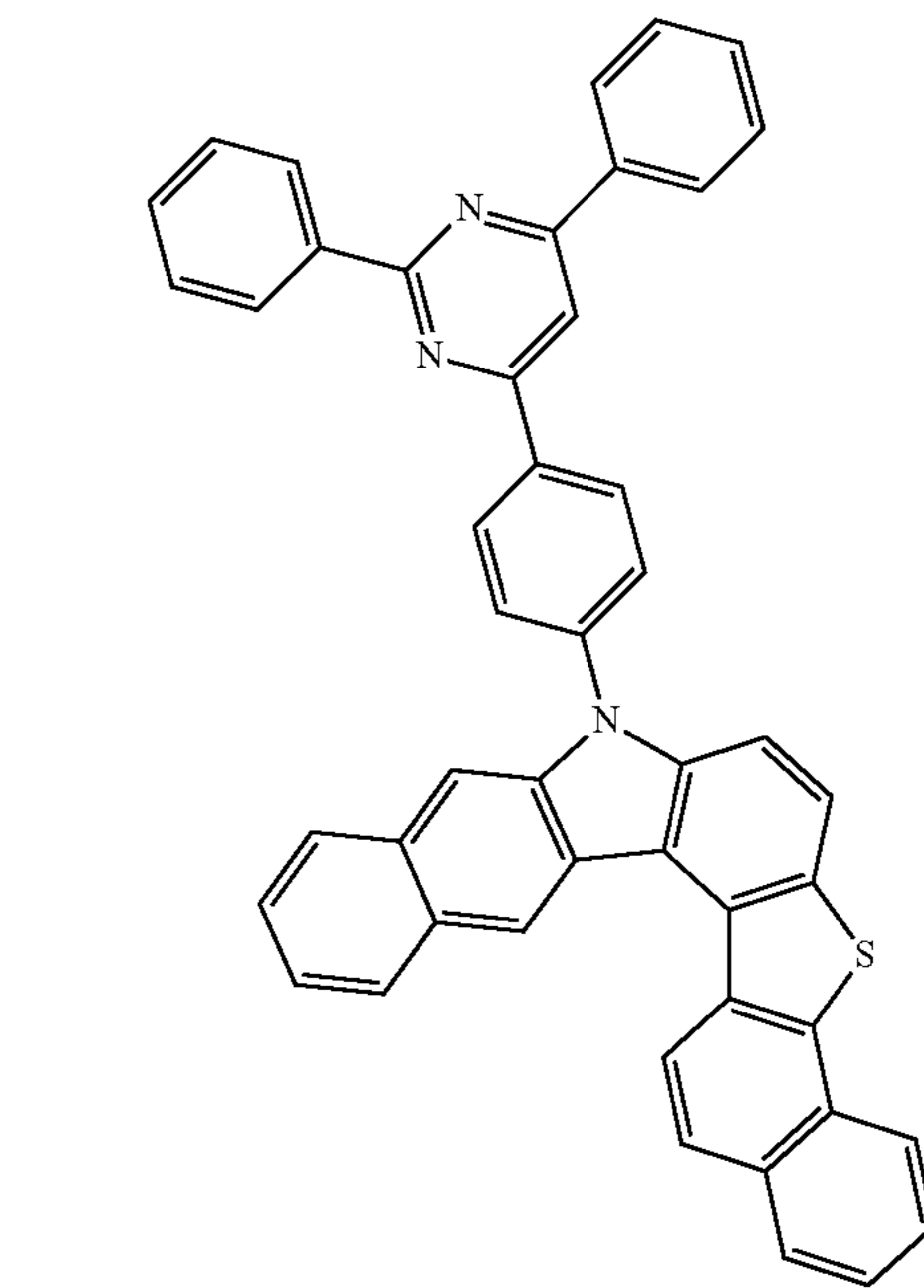
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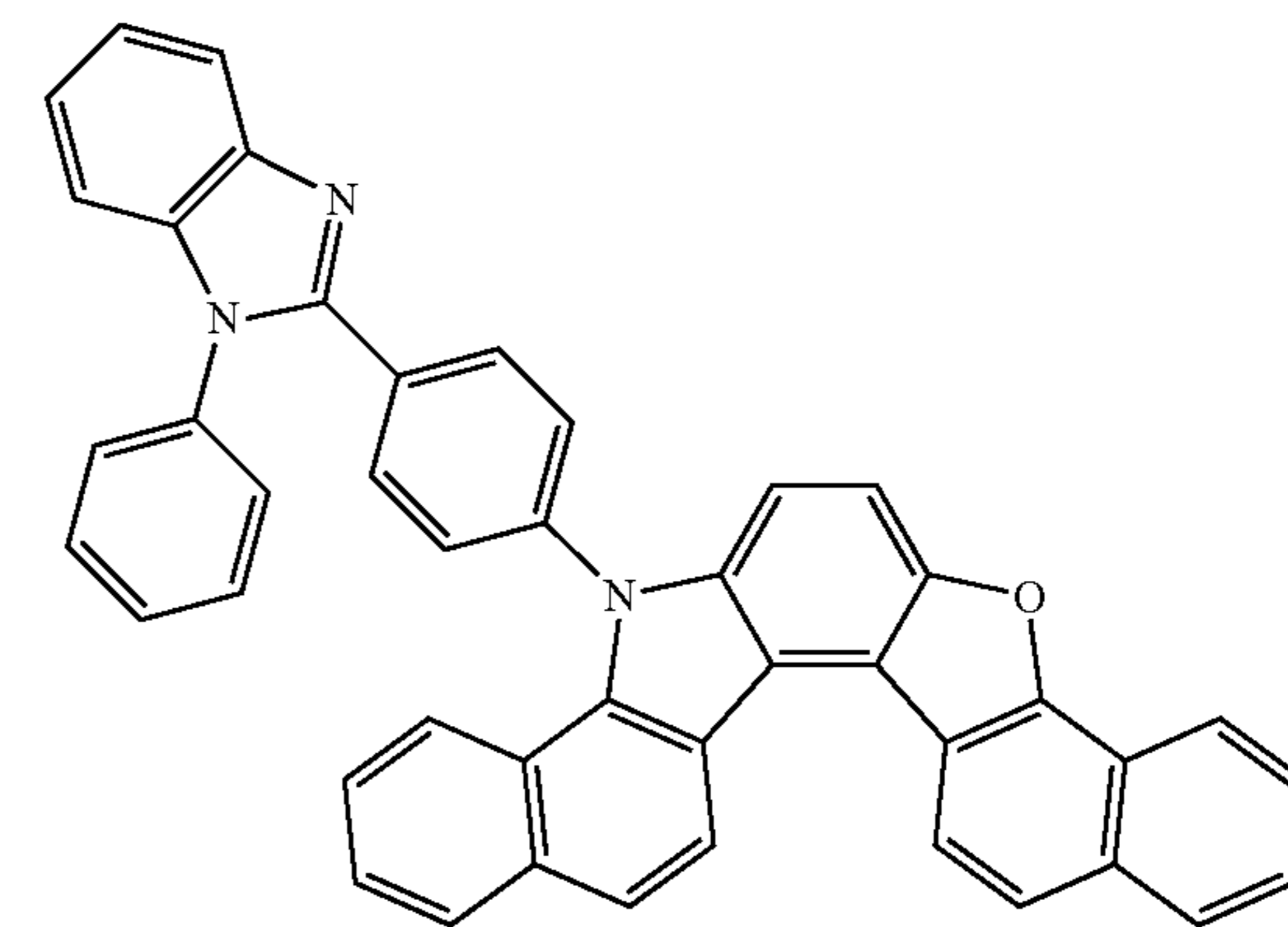


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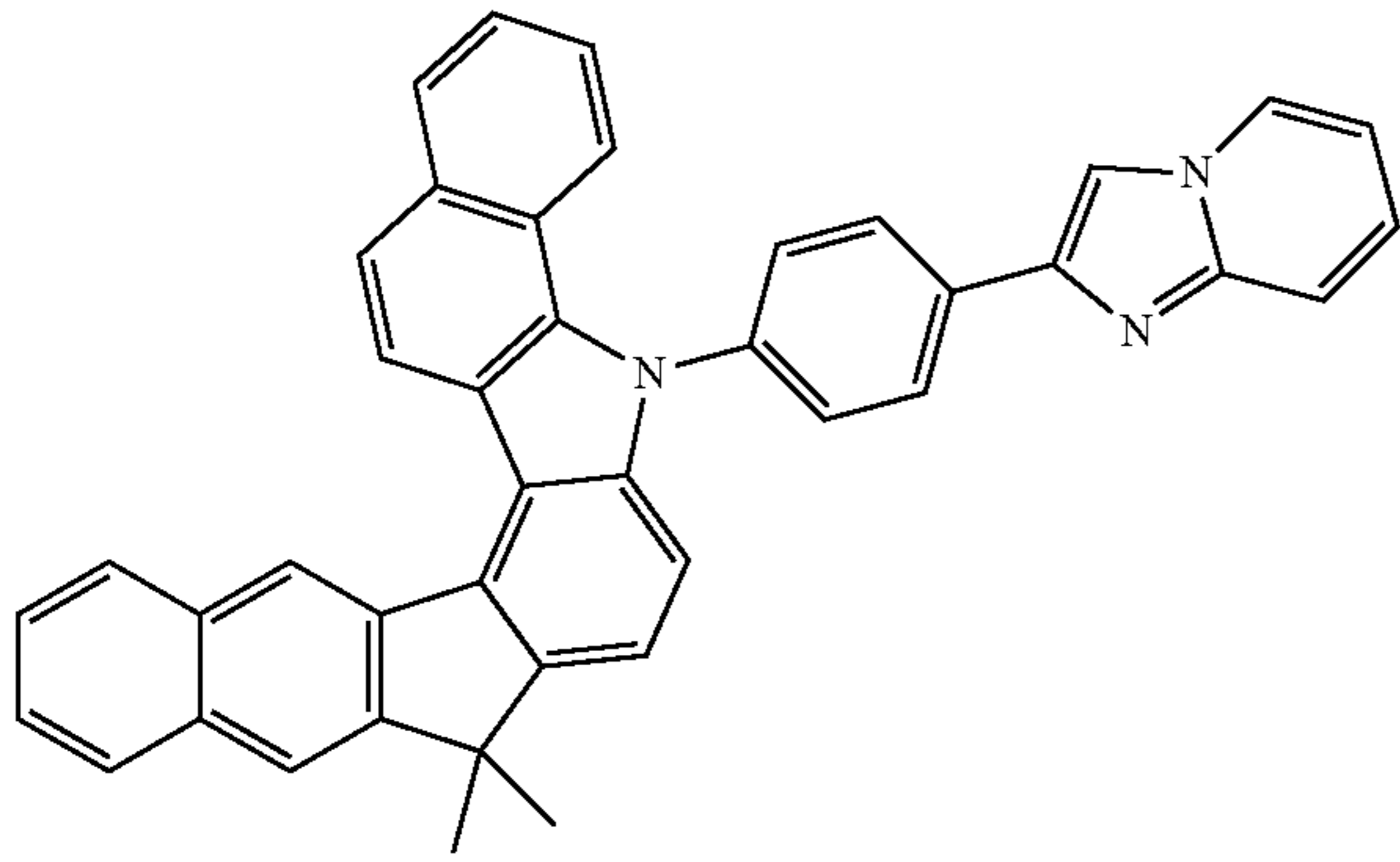
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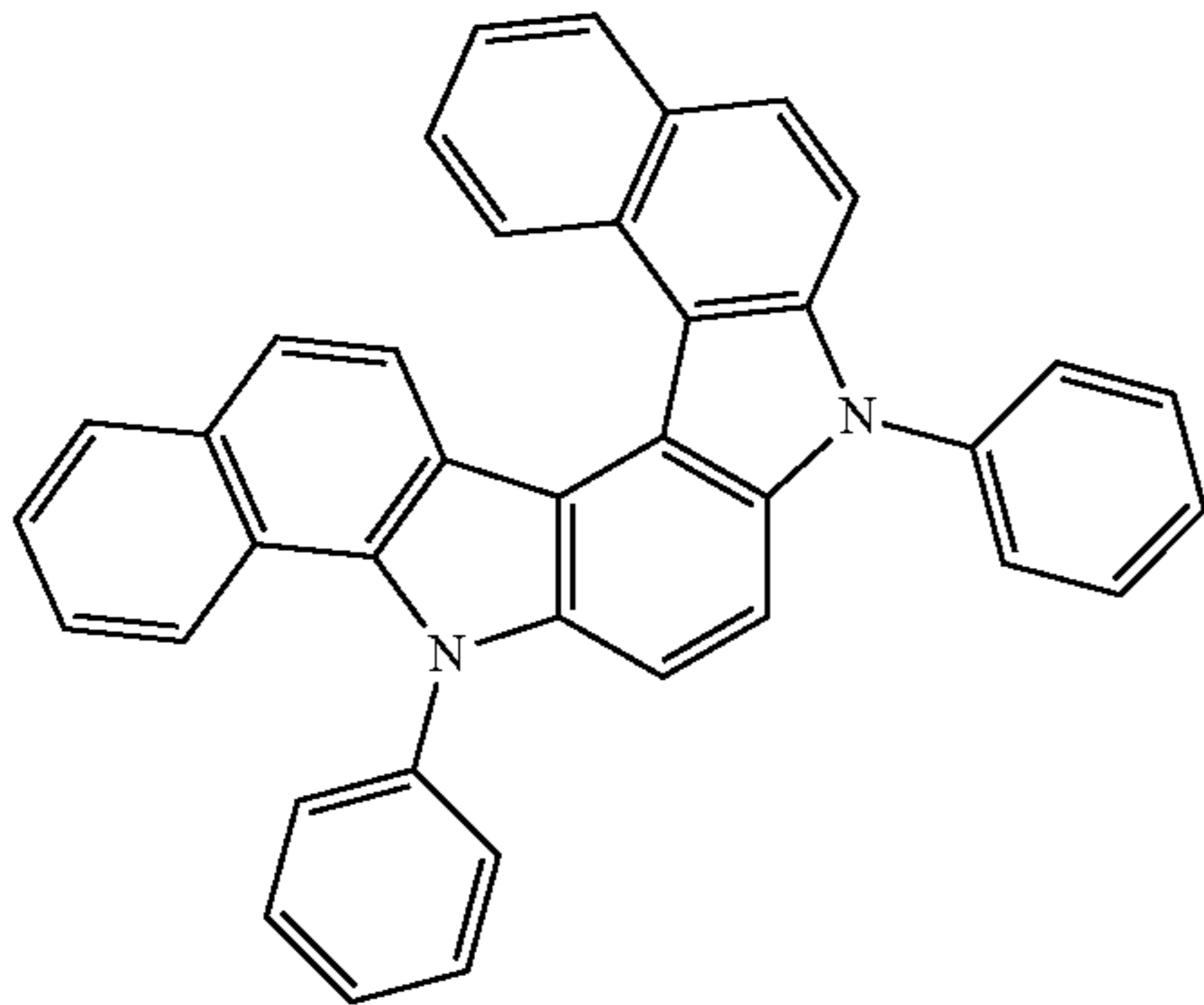
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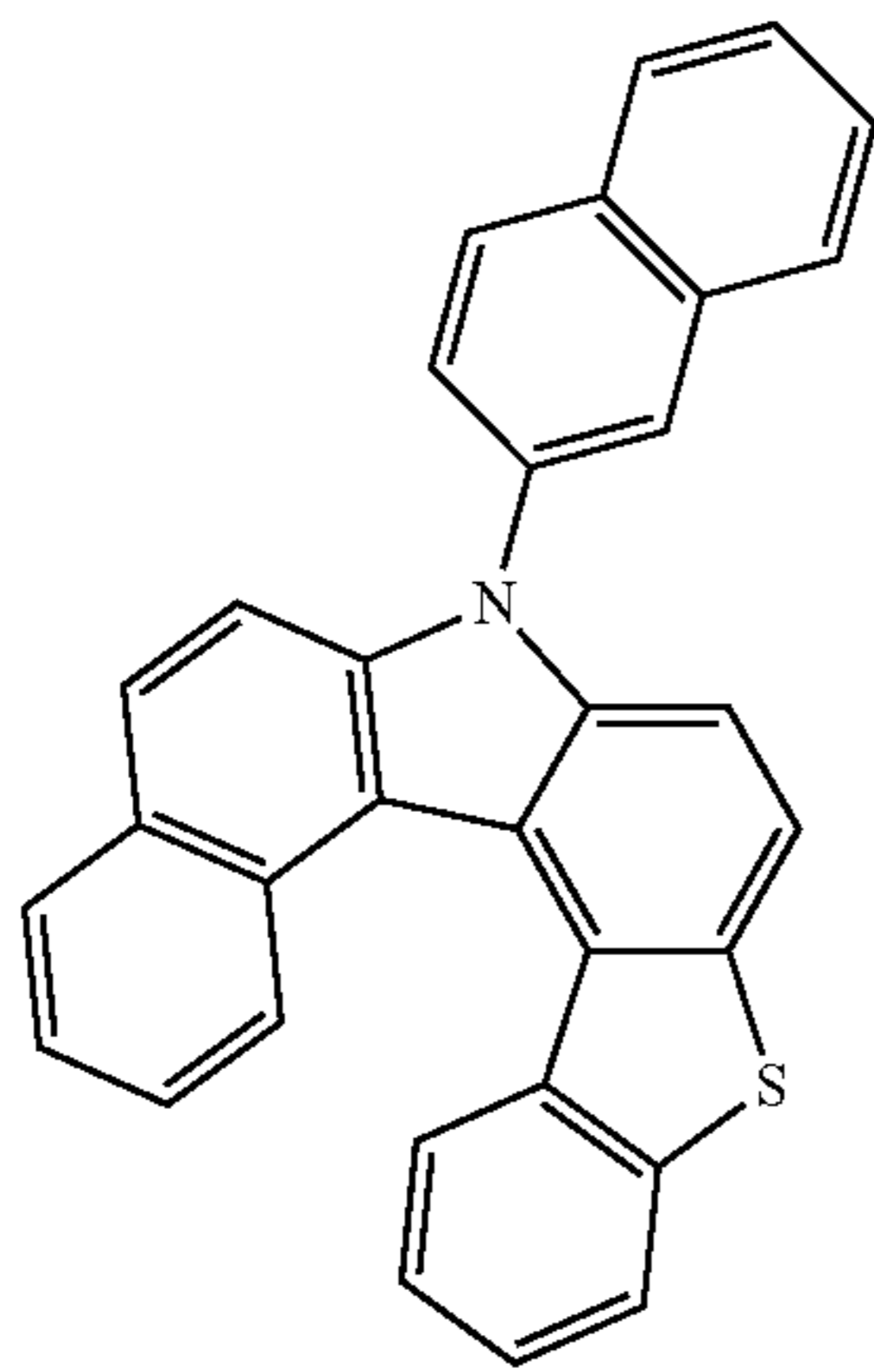
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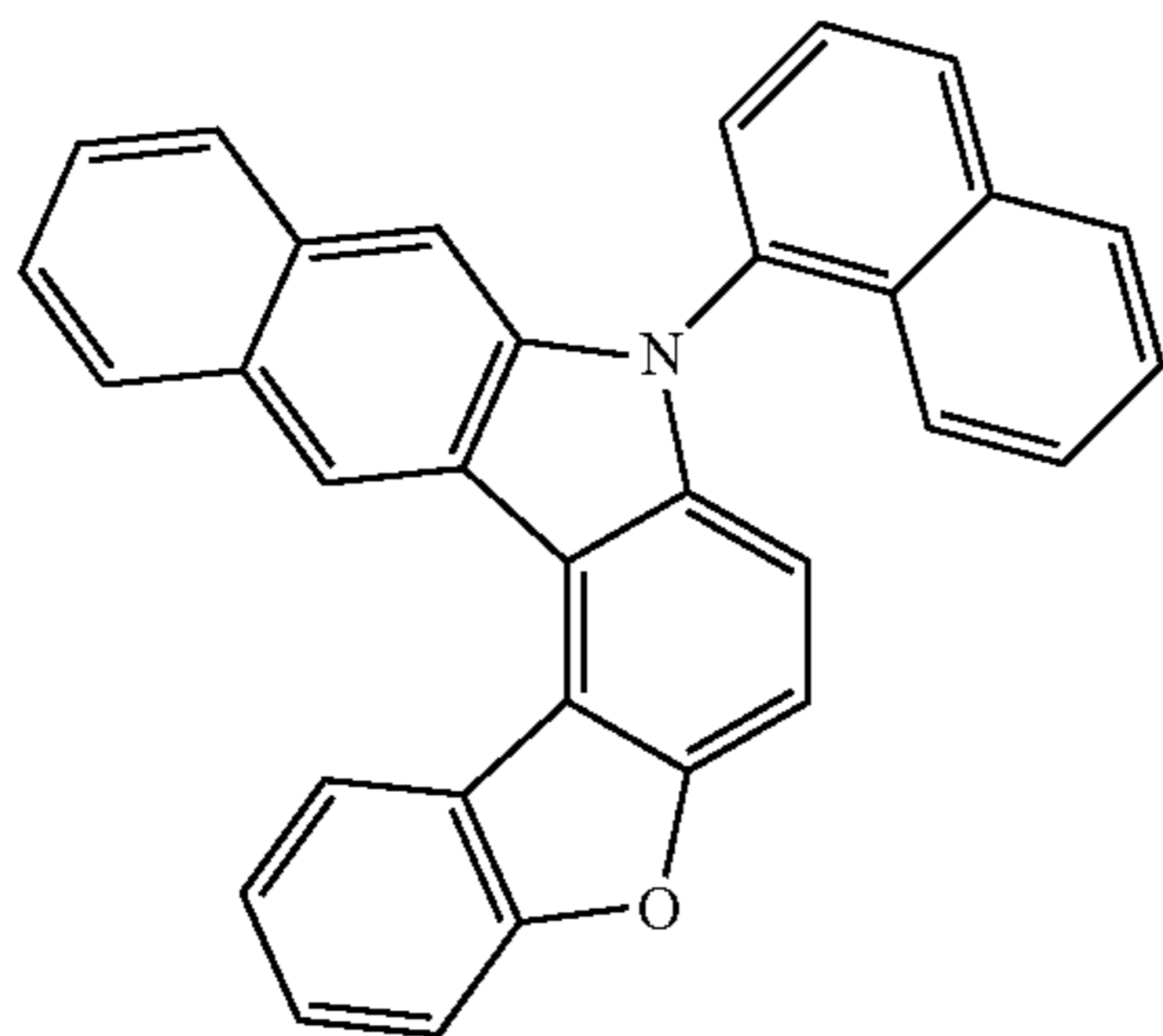
3-29 20



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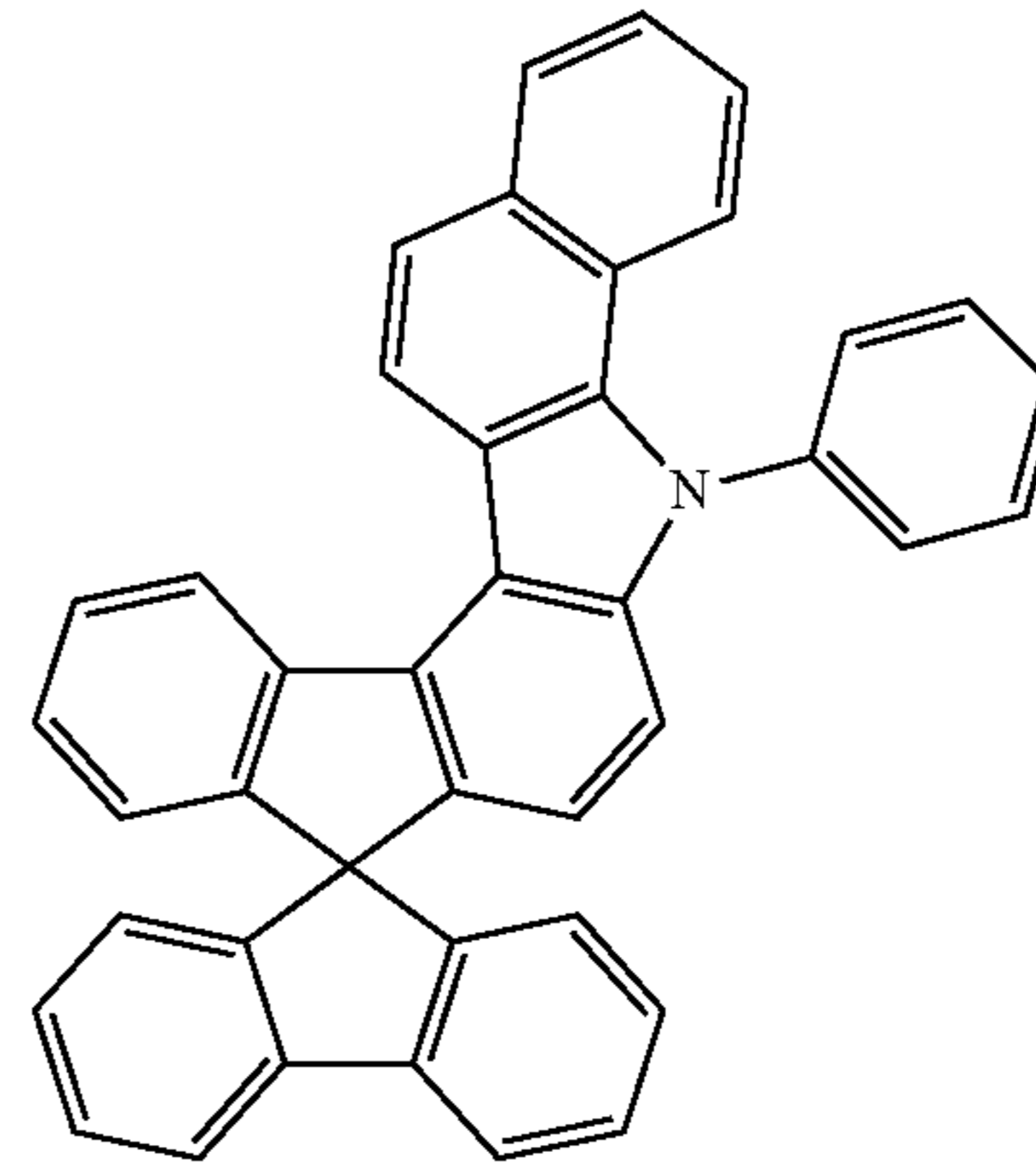
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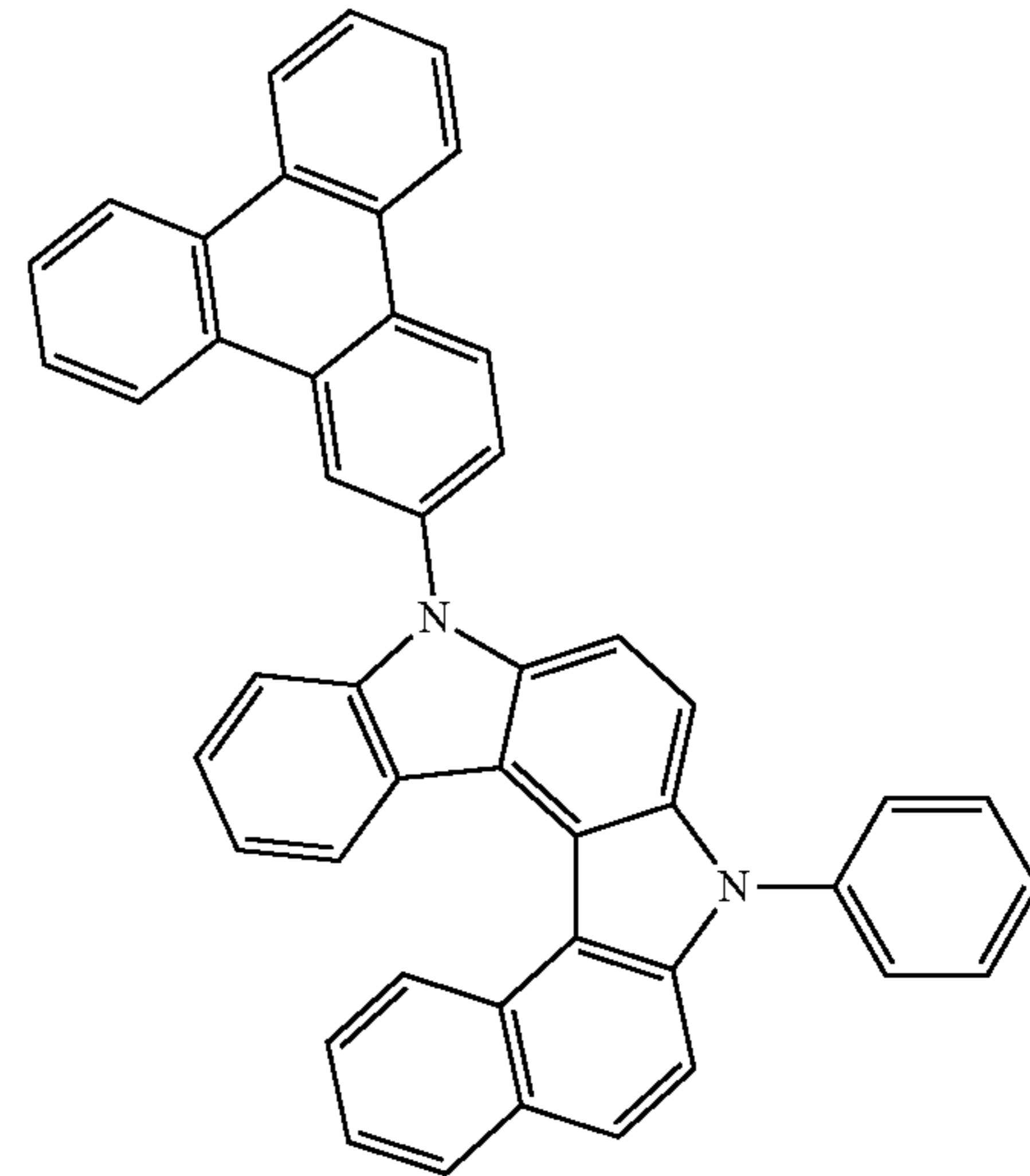
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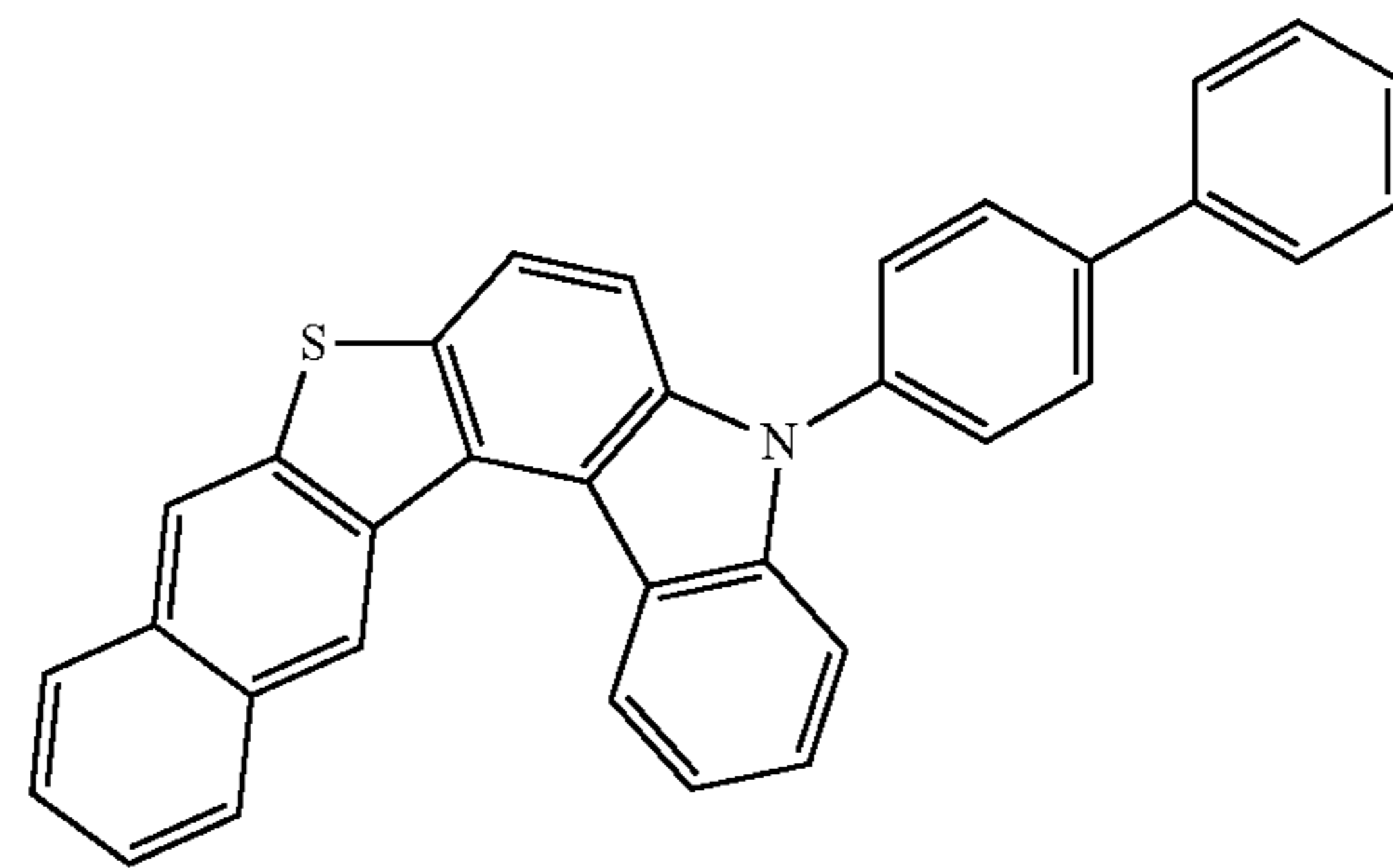
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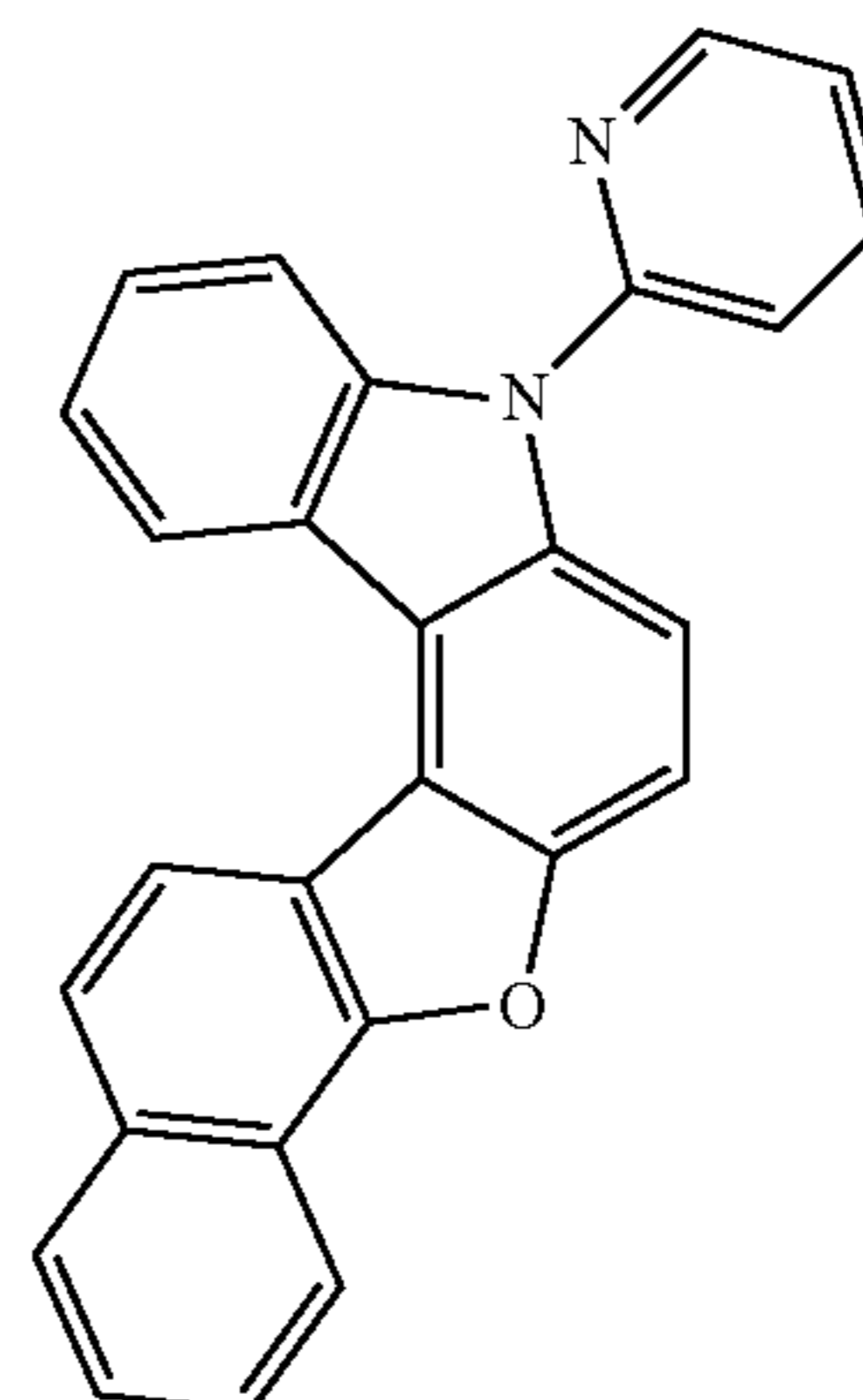
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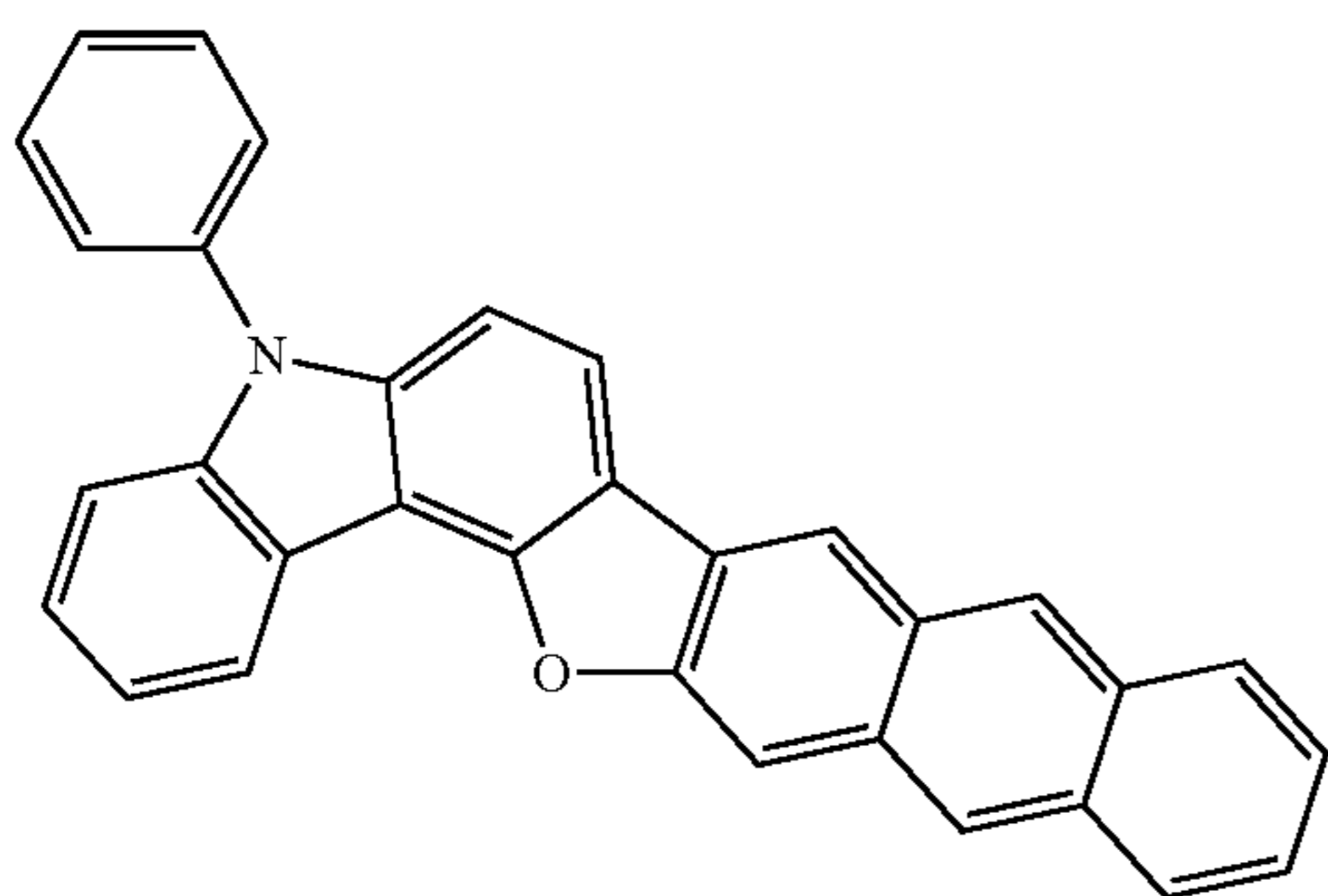
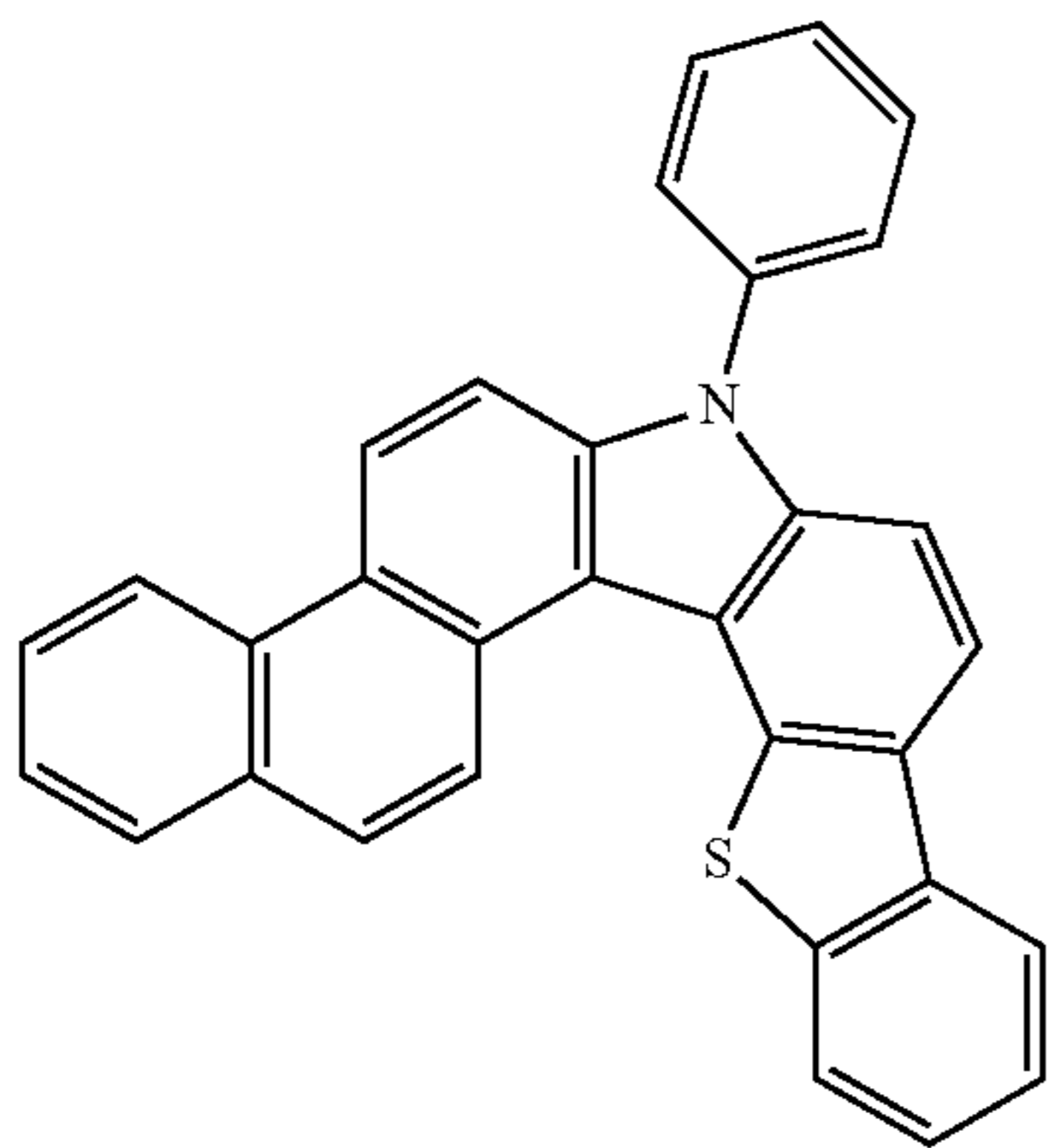
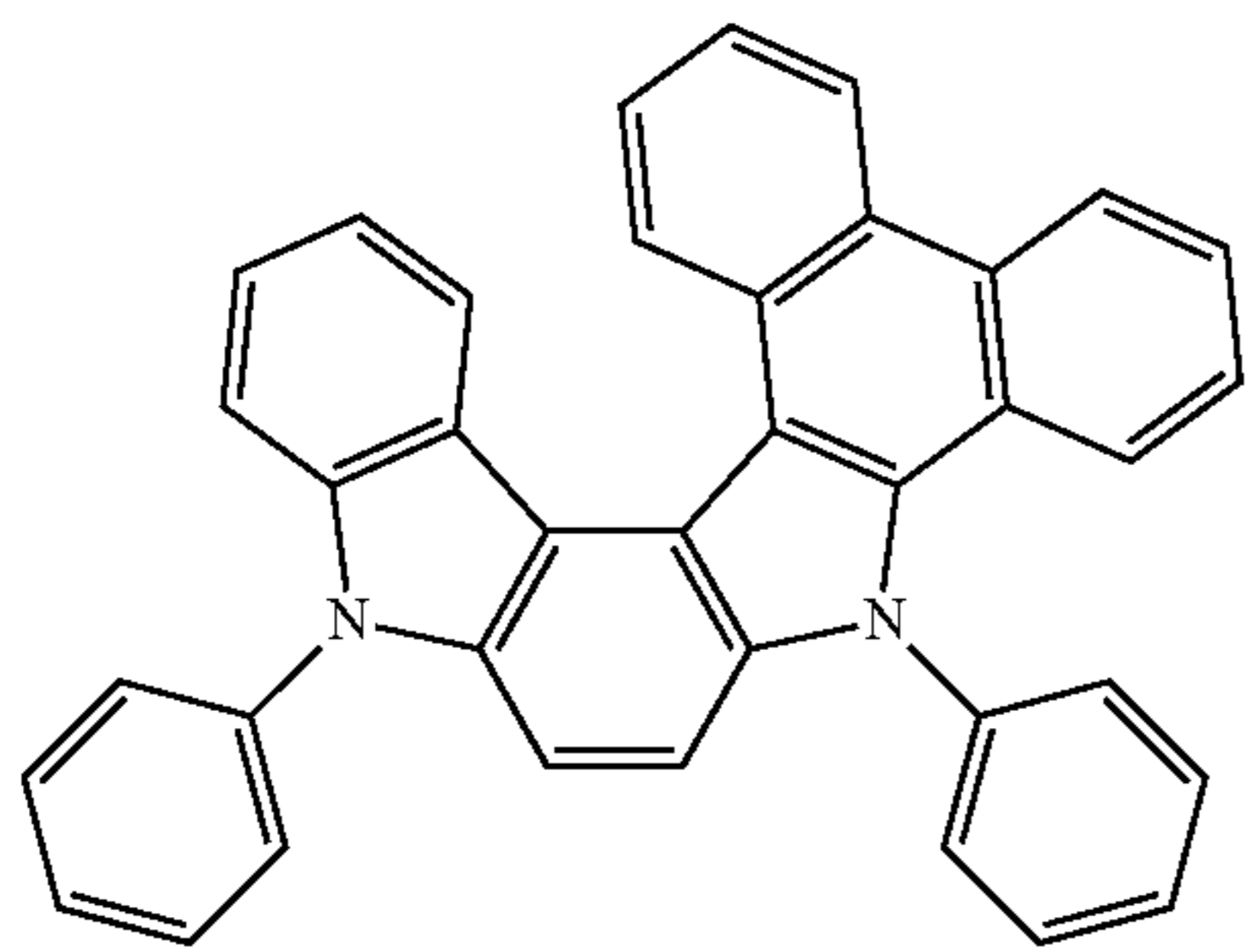
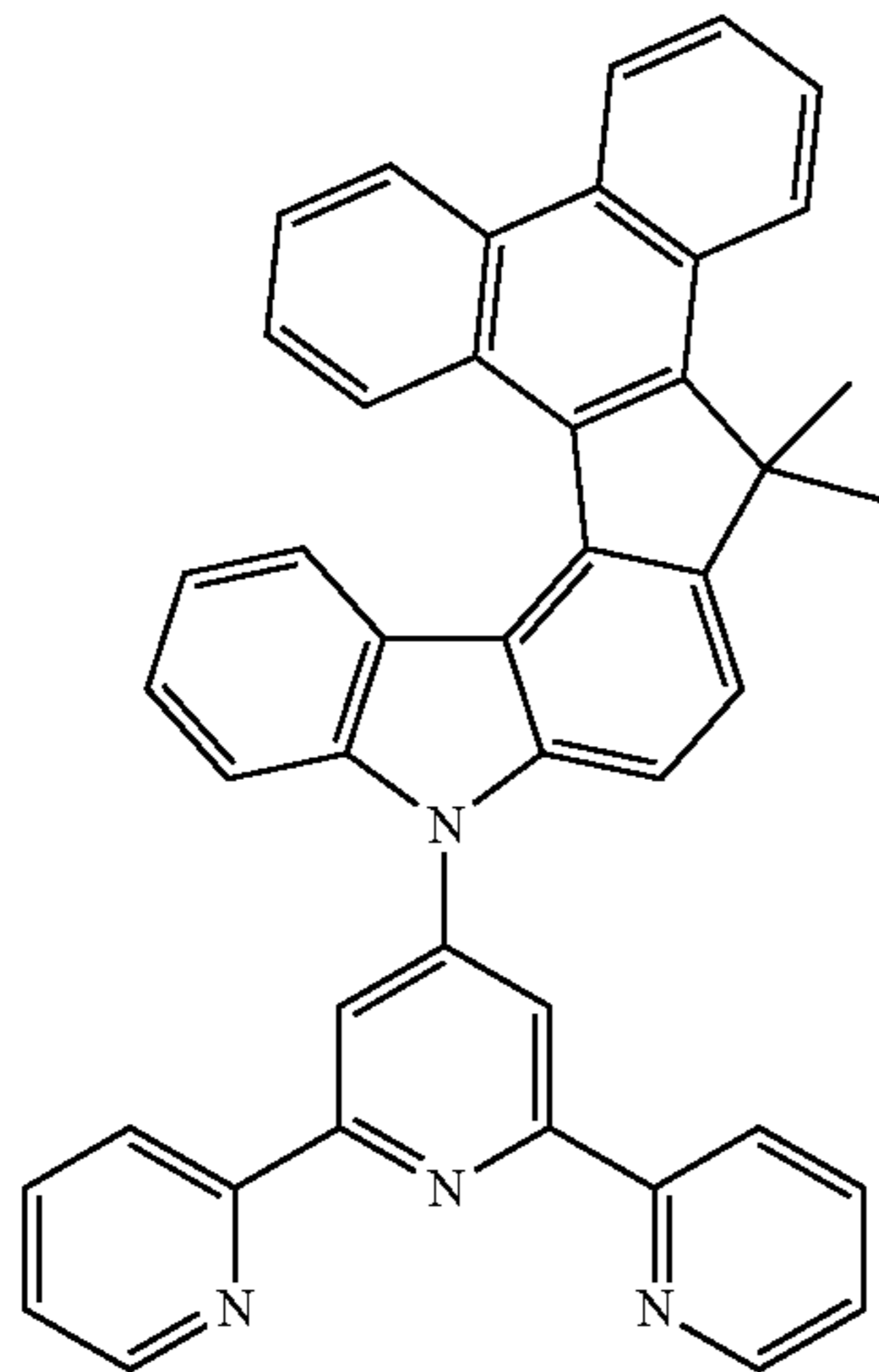


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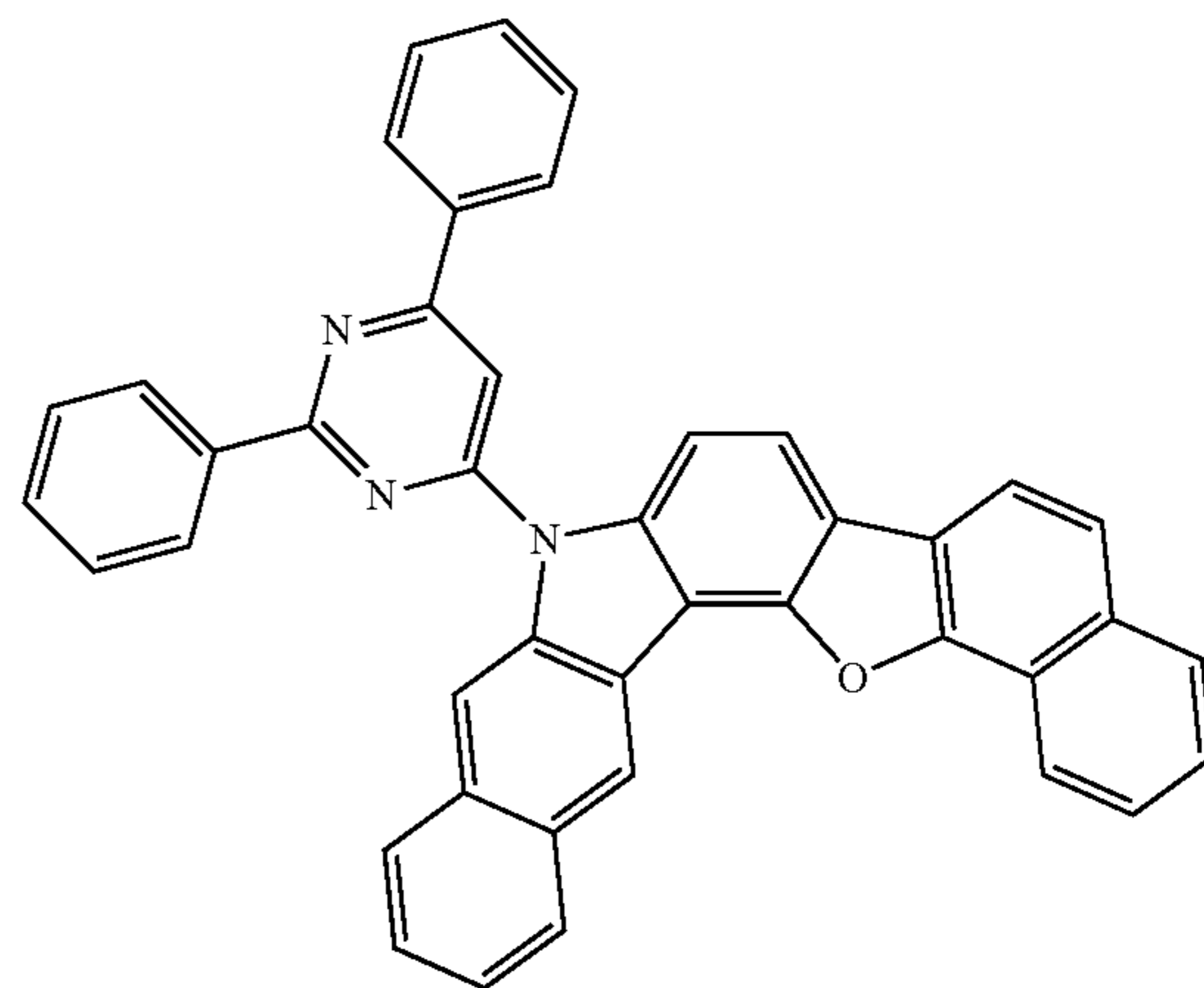
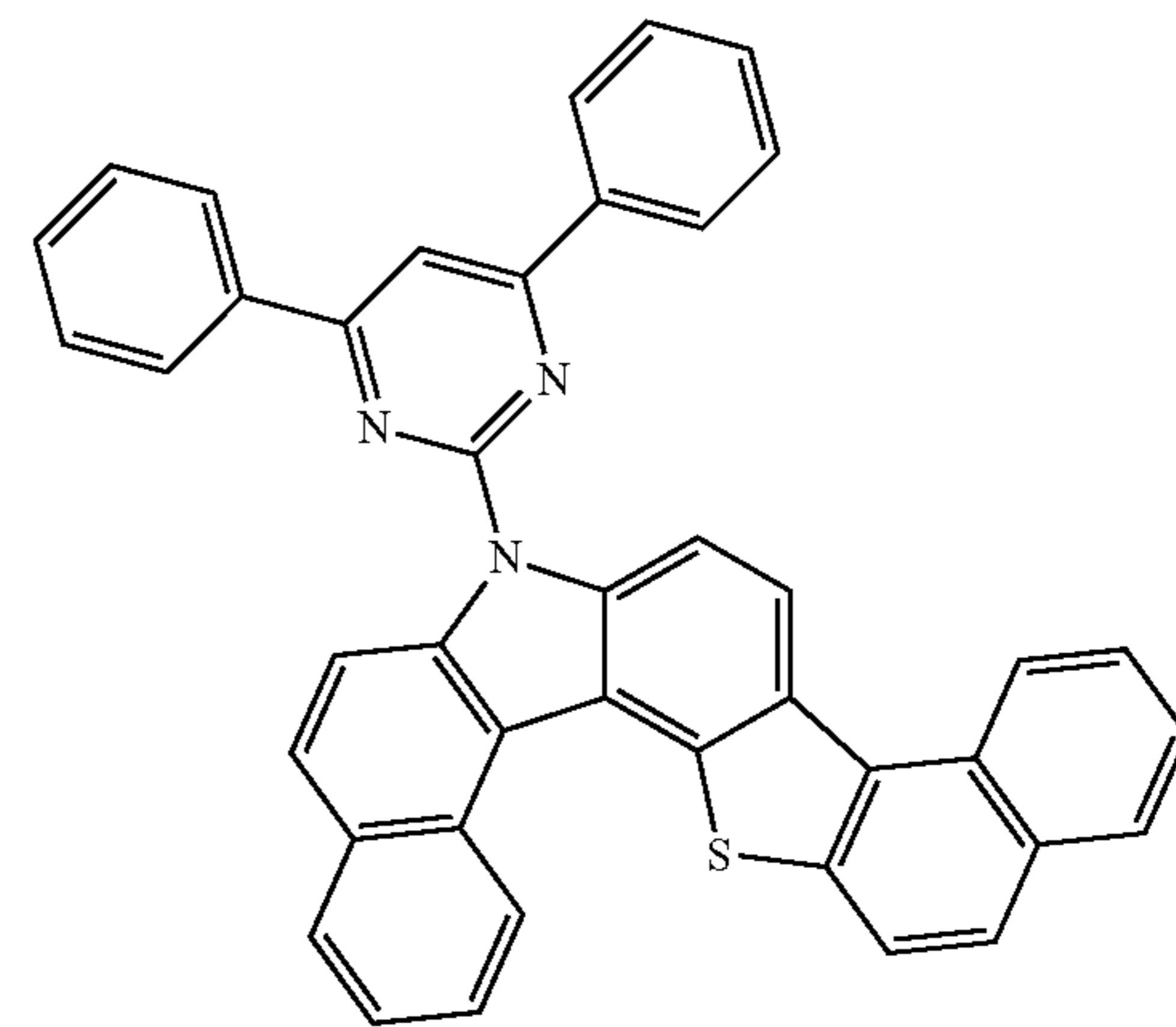
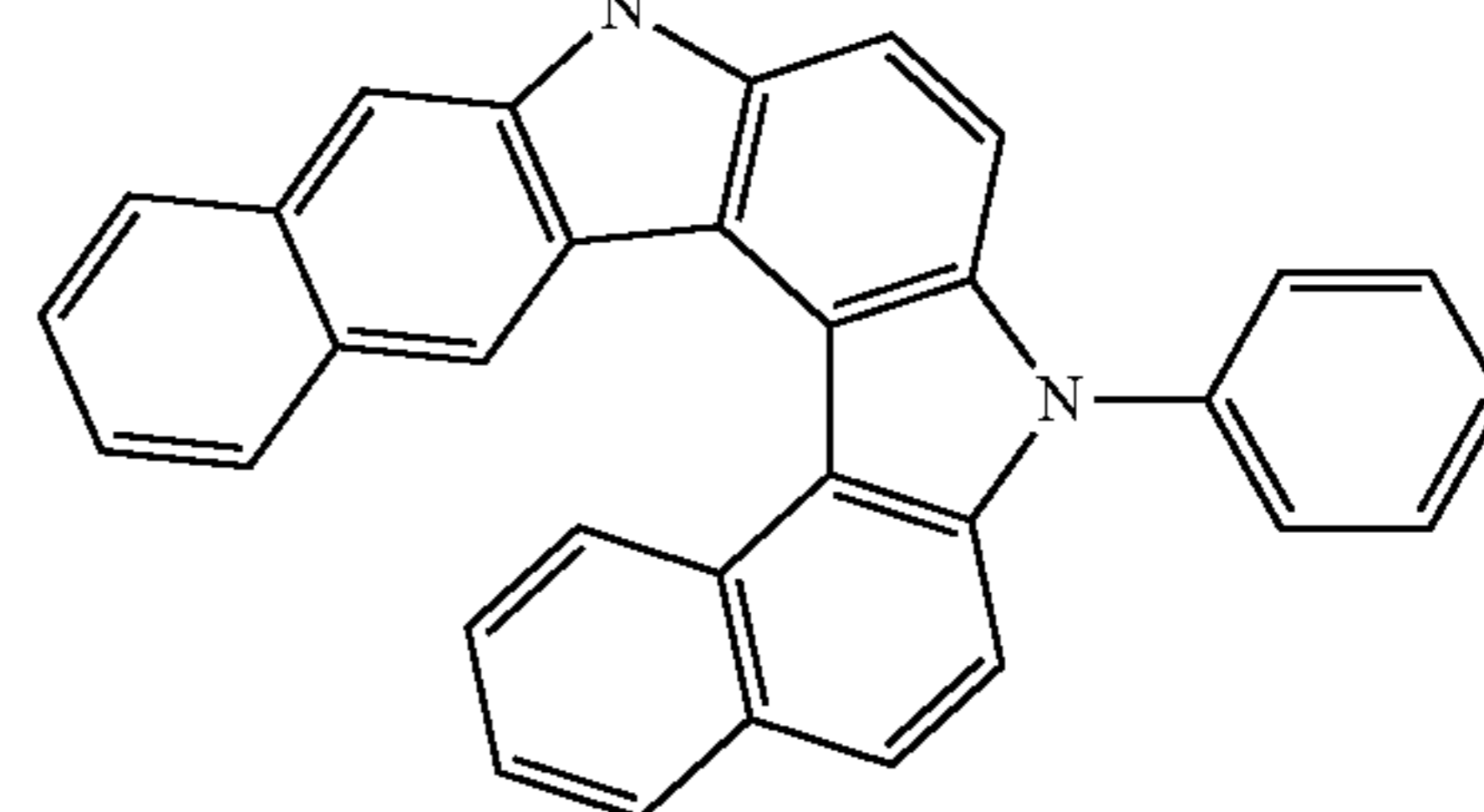
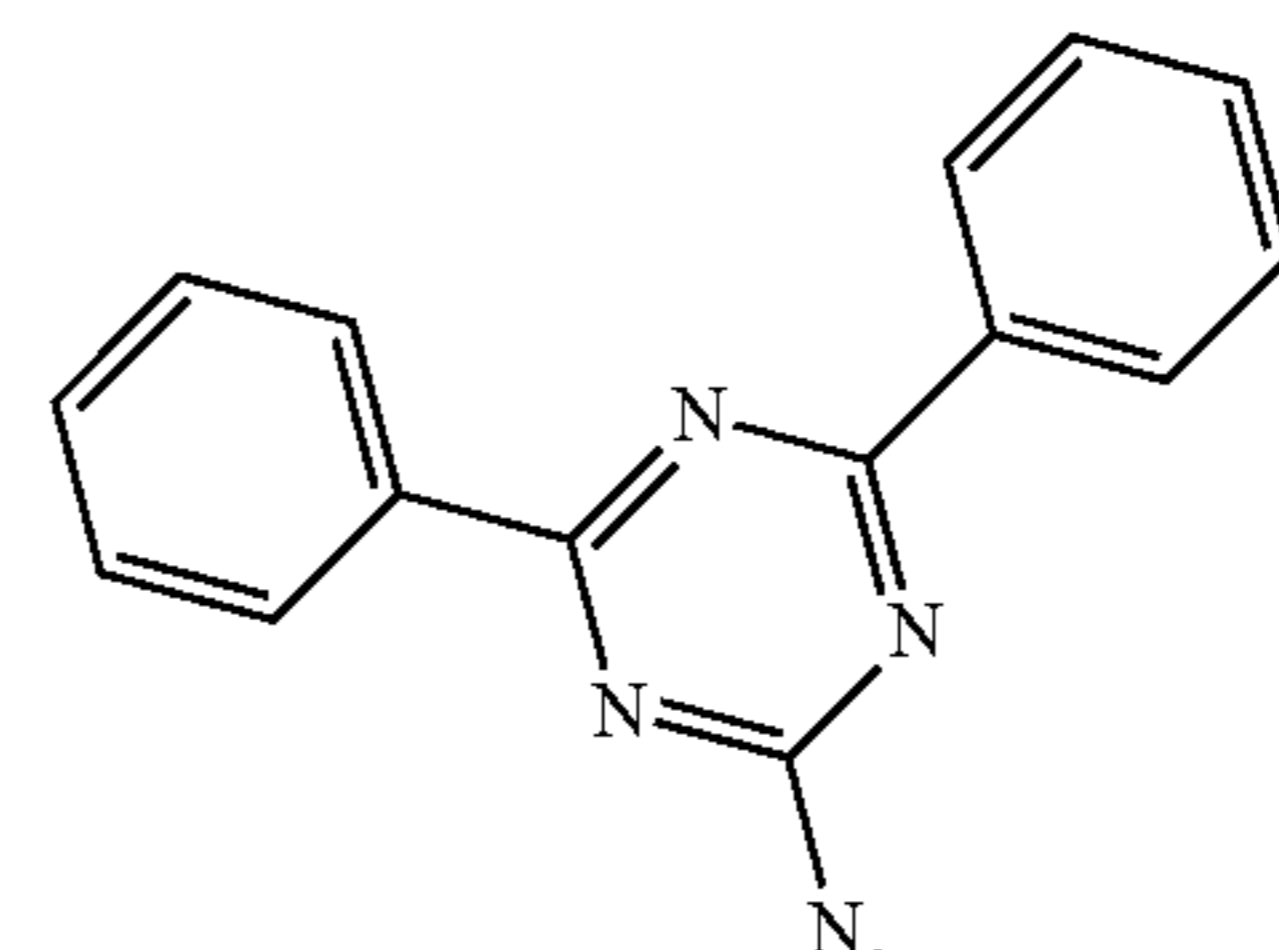
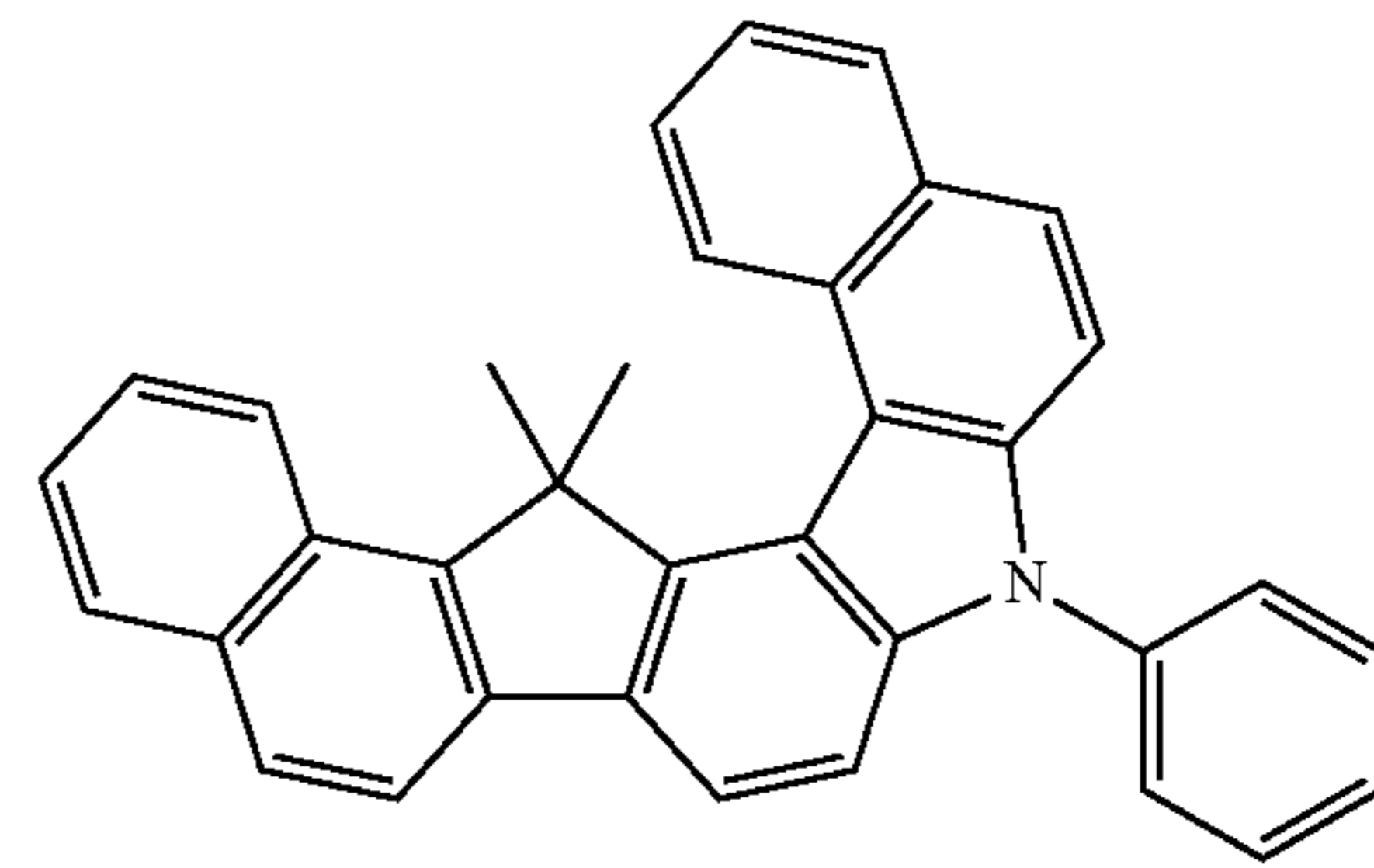
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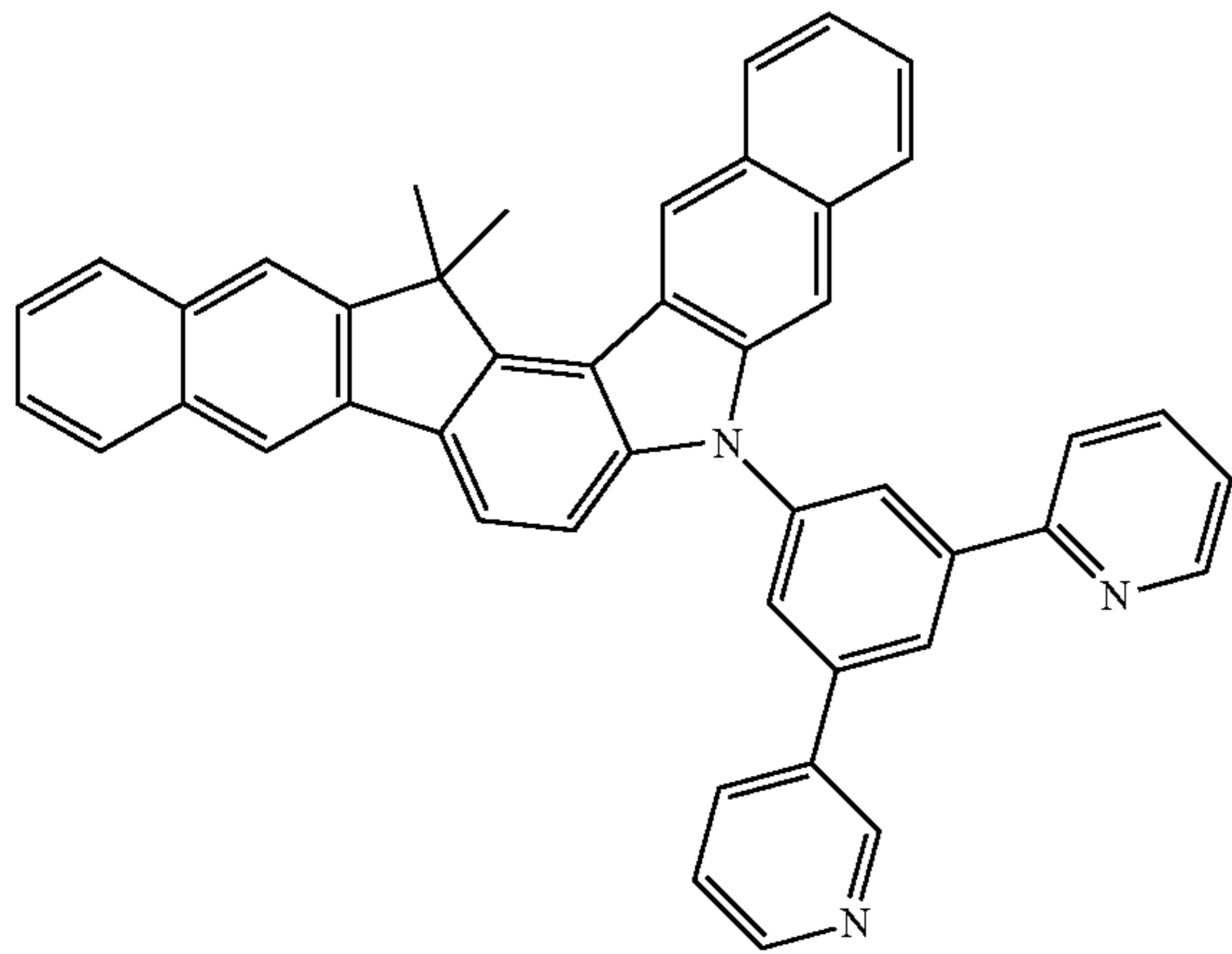
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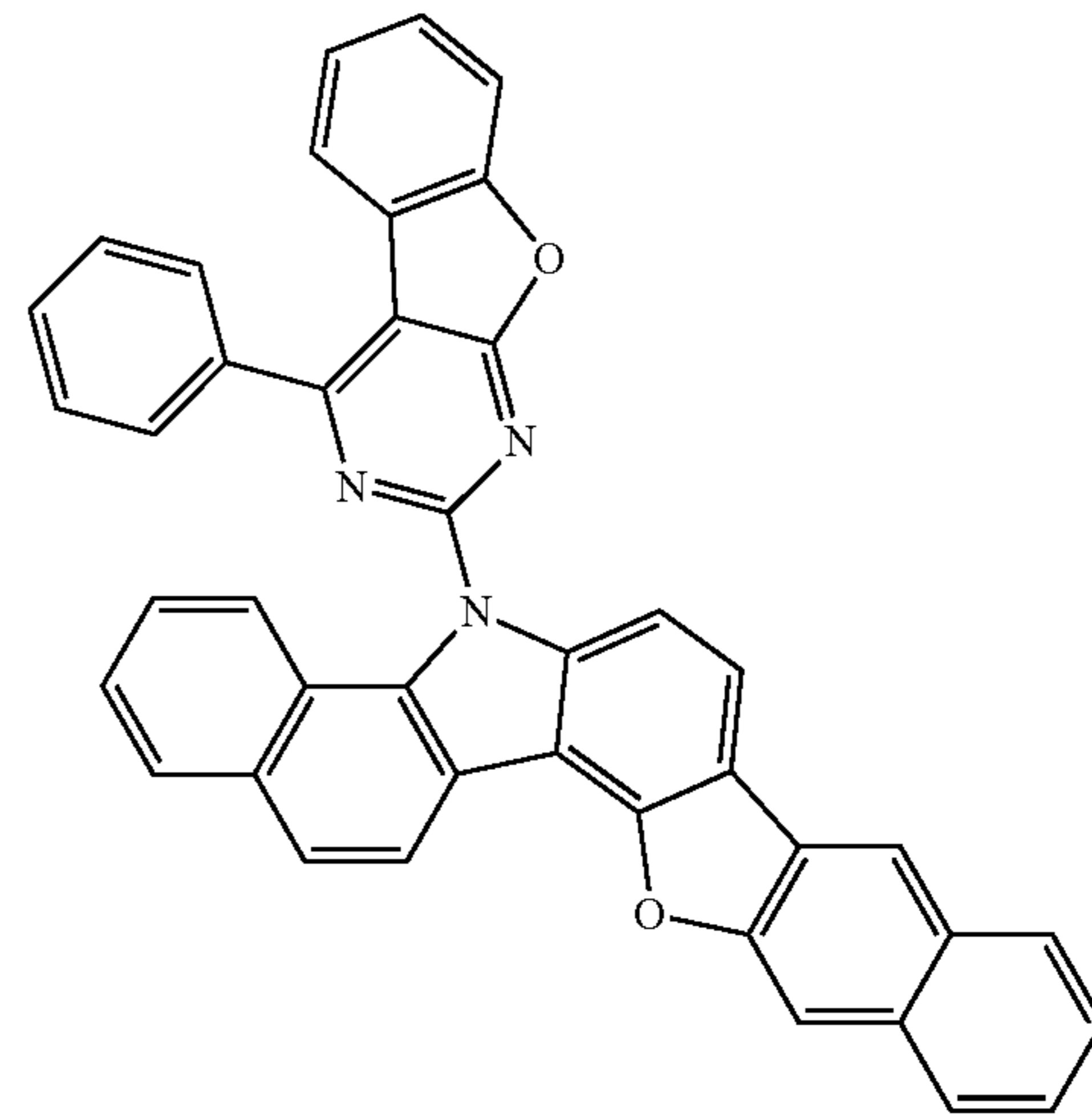
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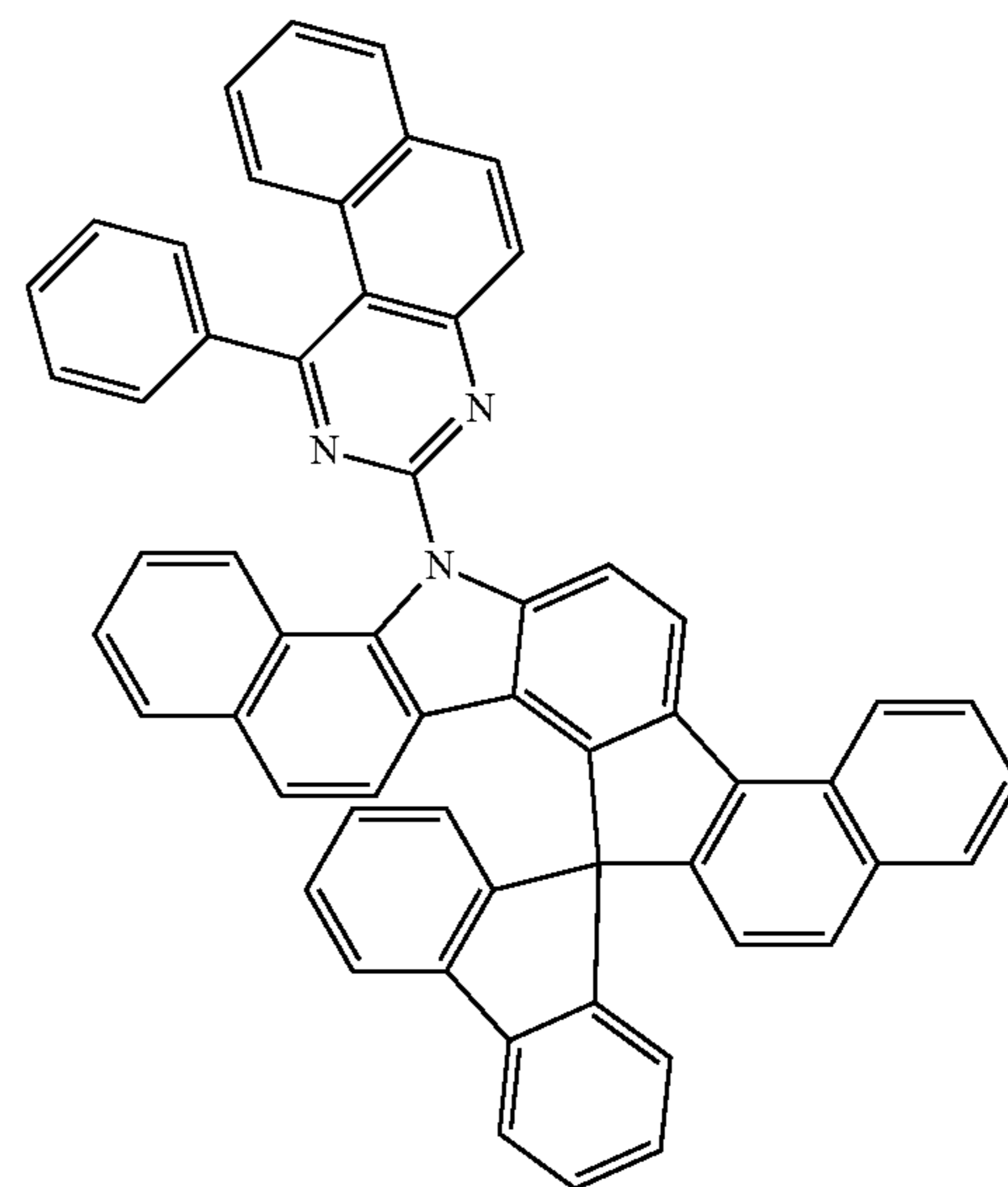
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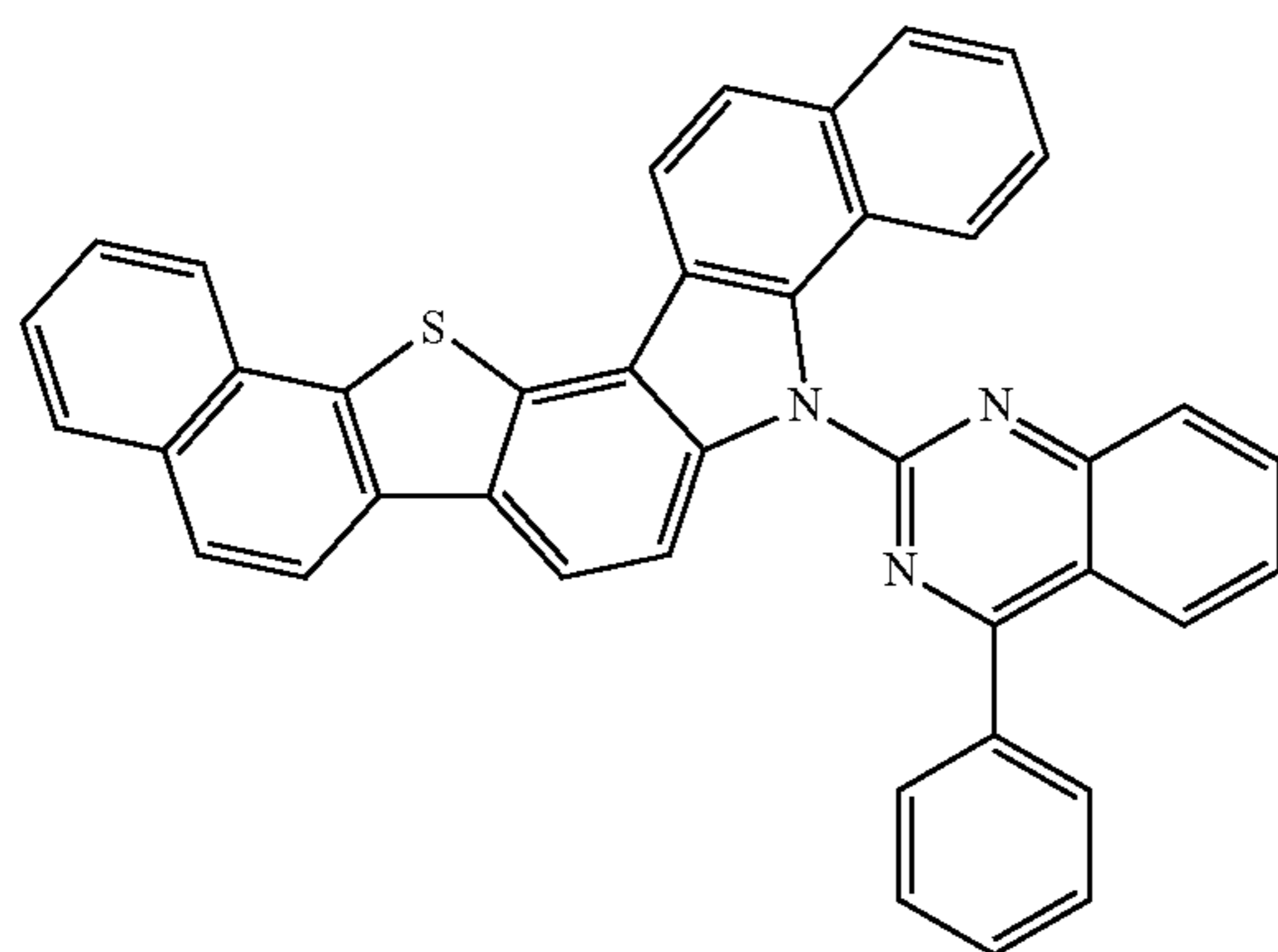
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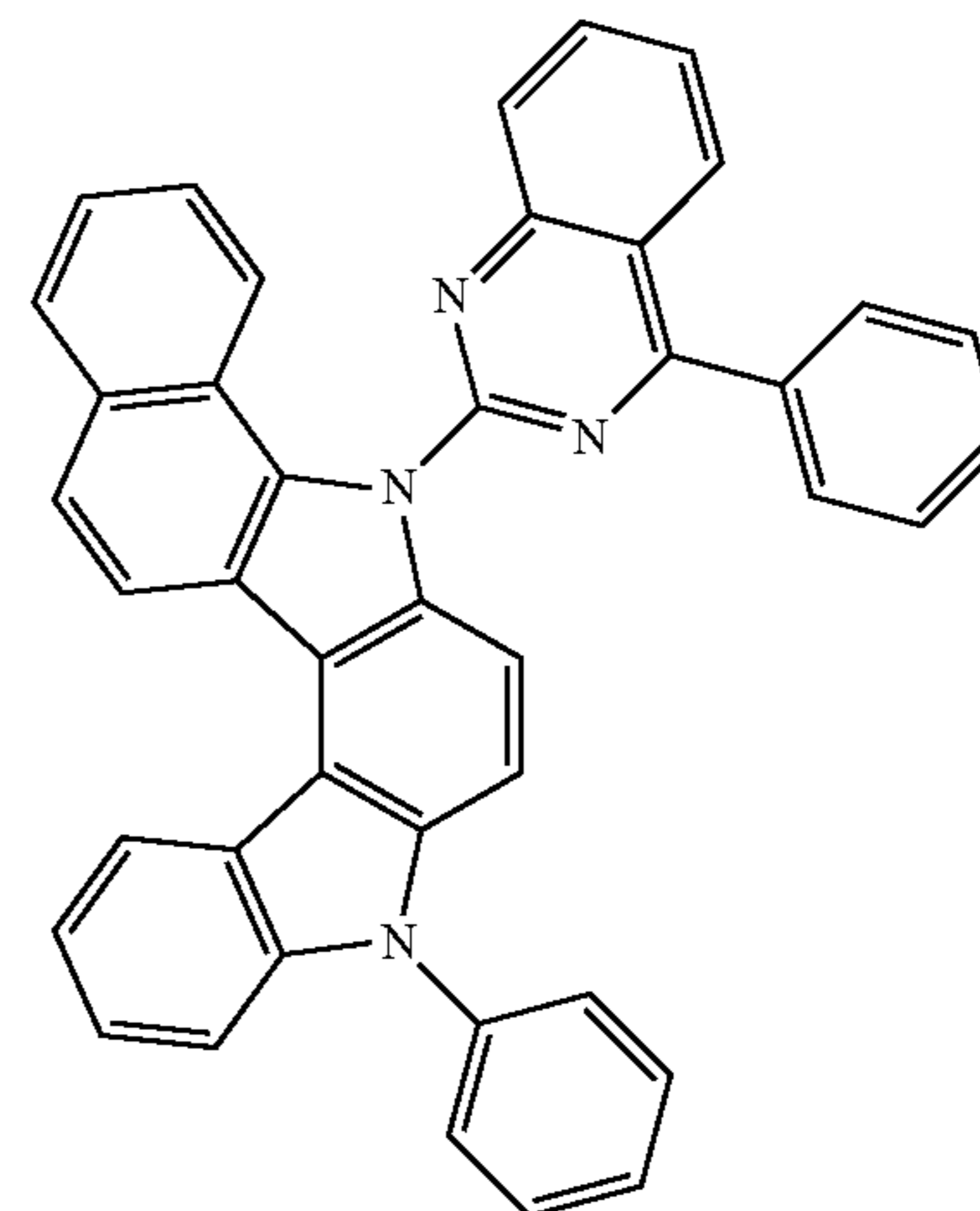
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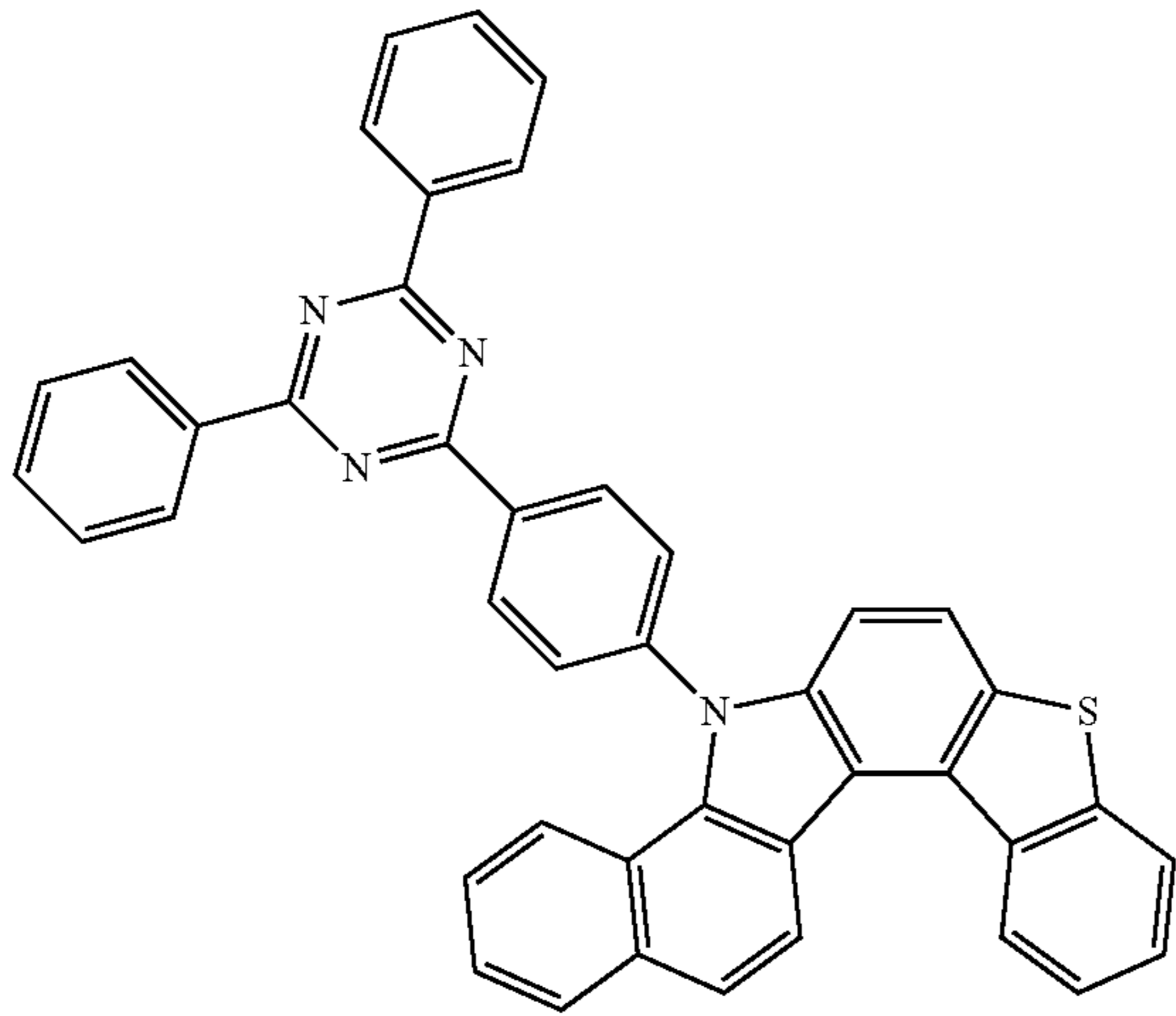
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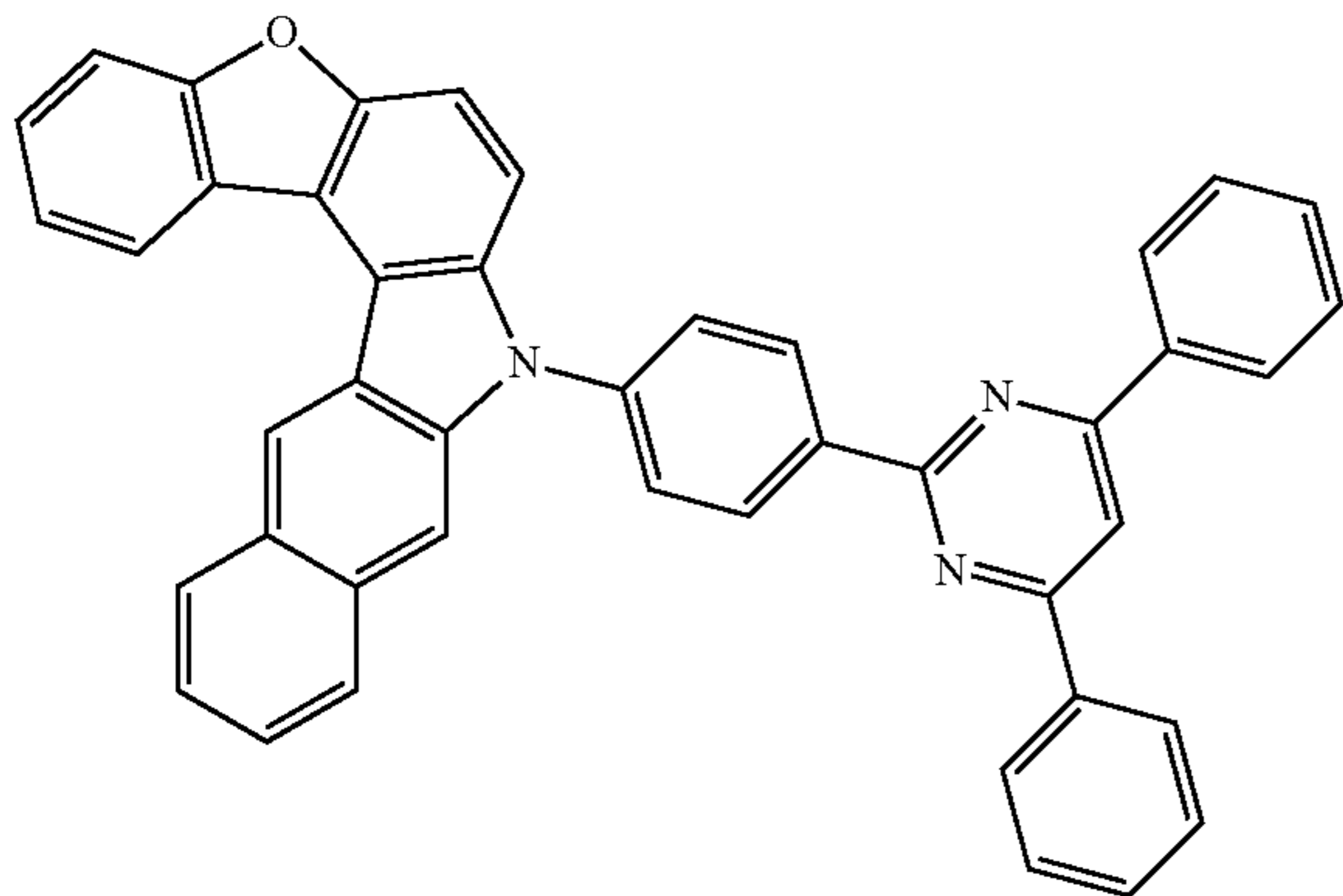
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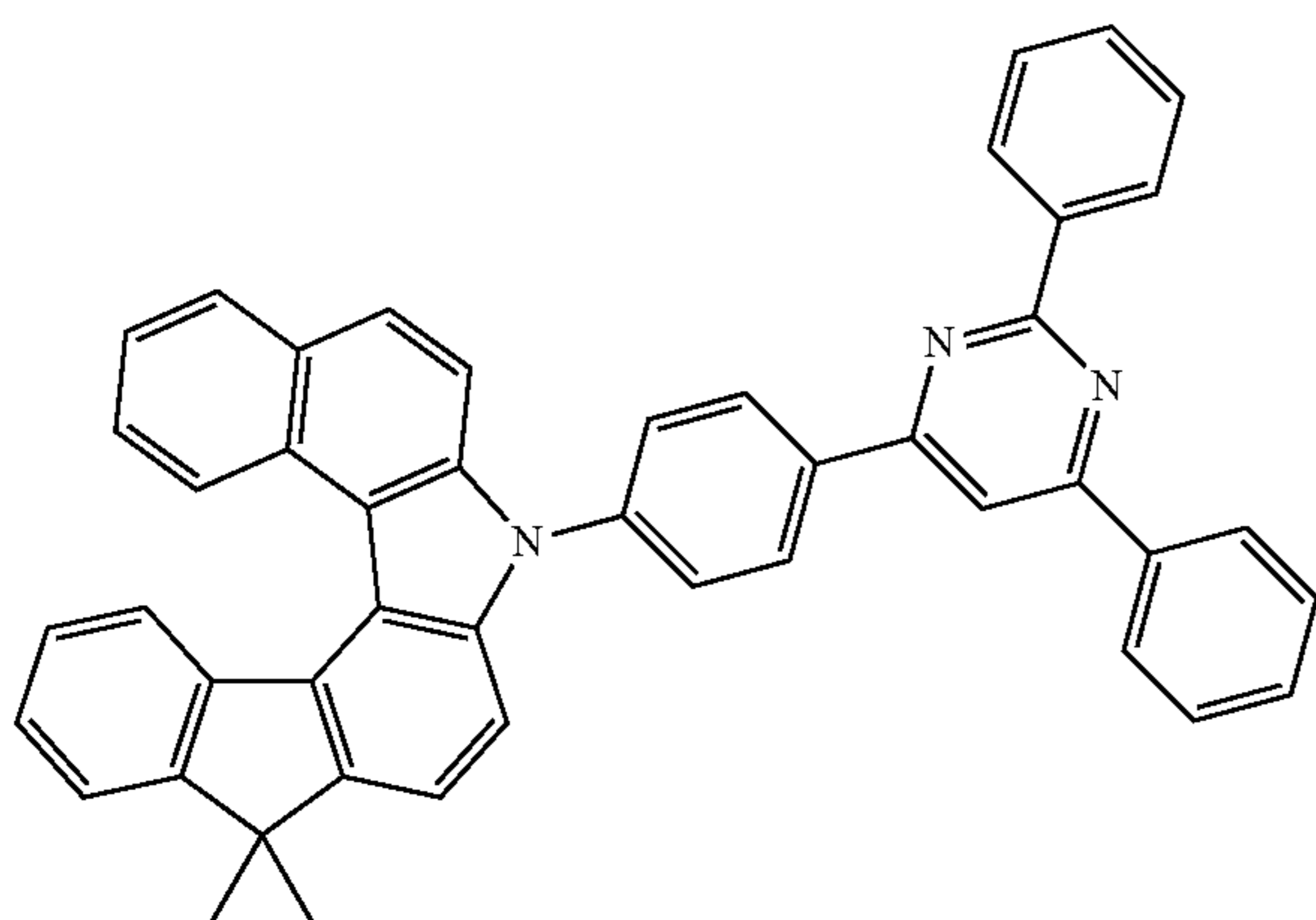
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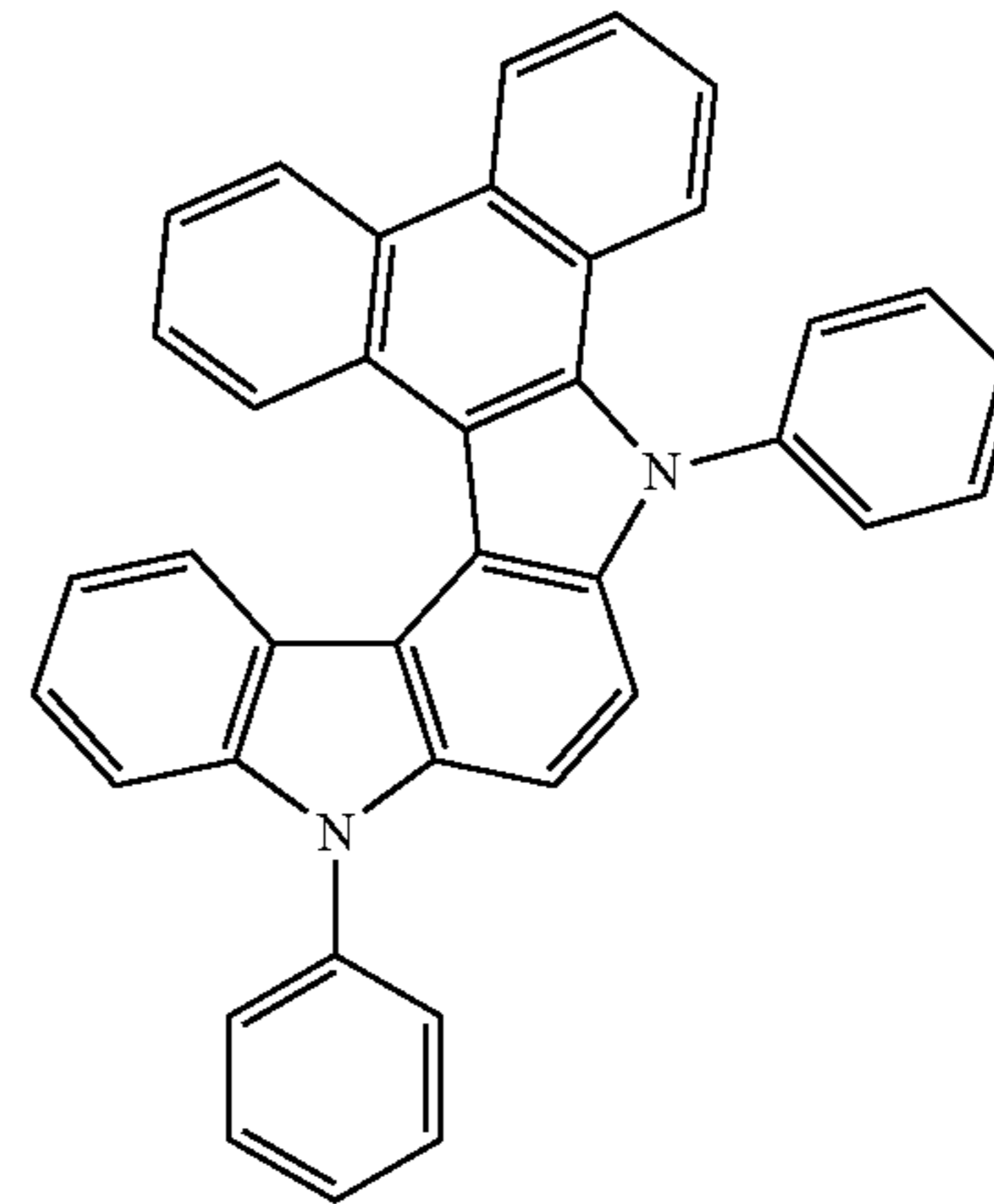
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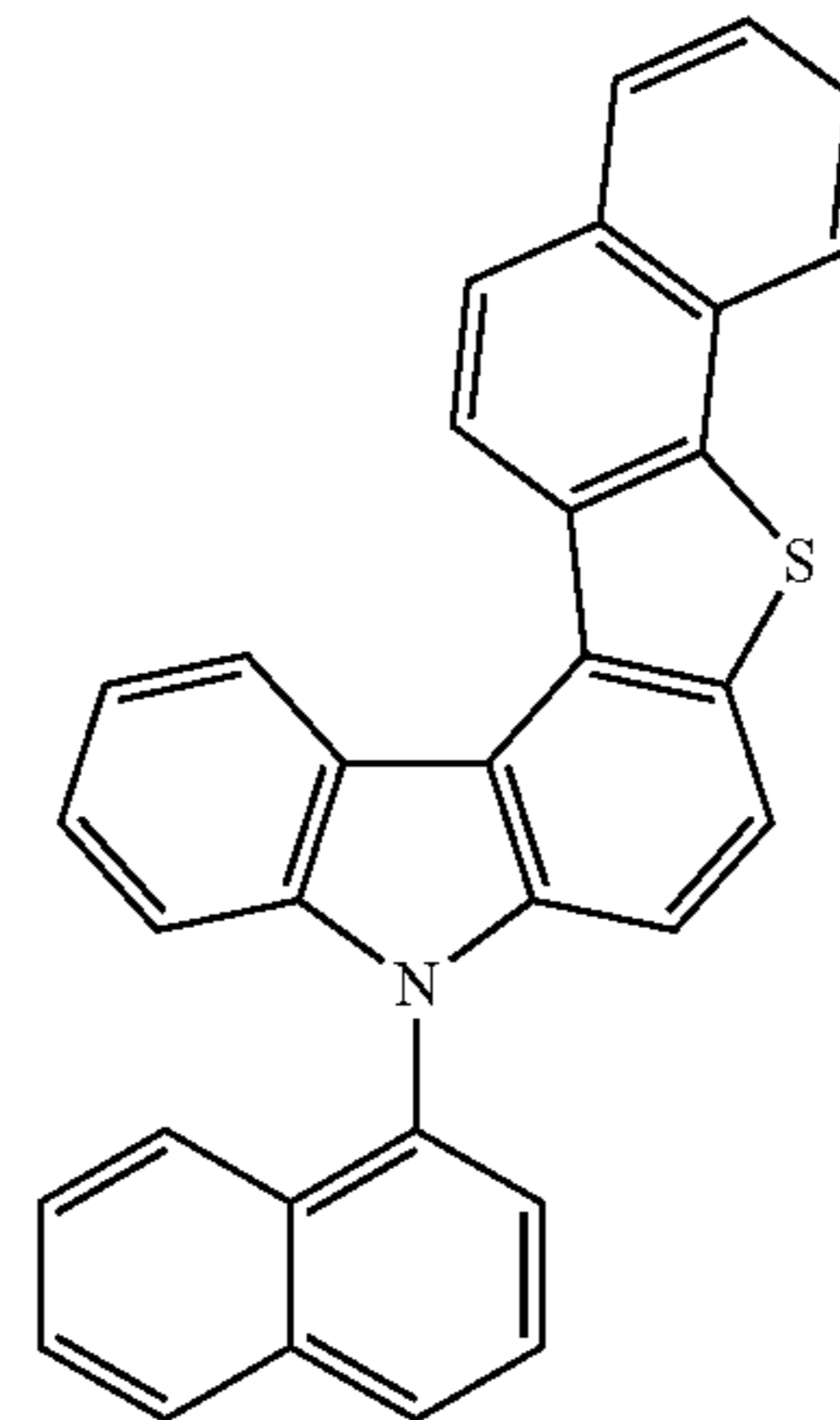
228

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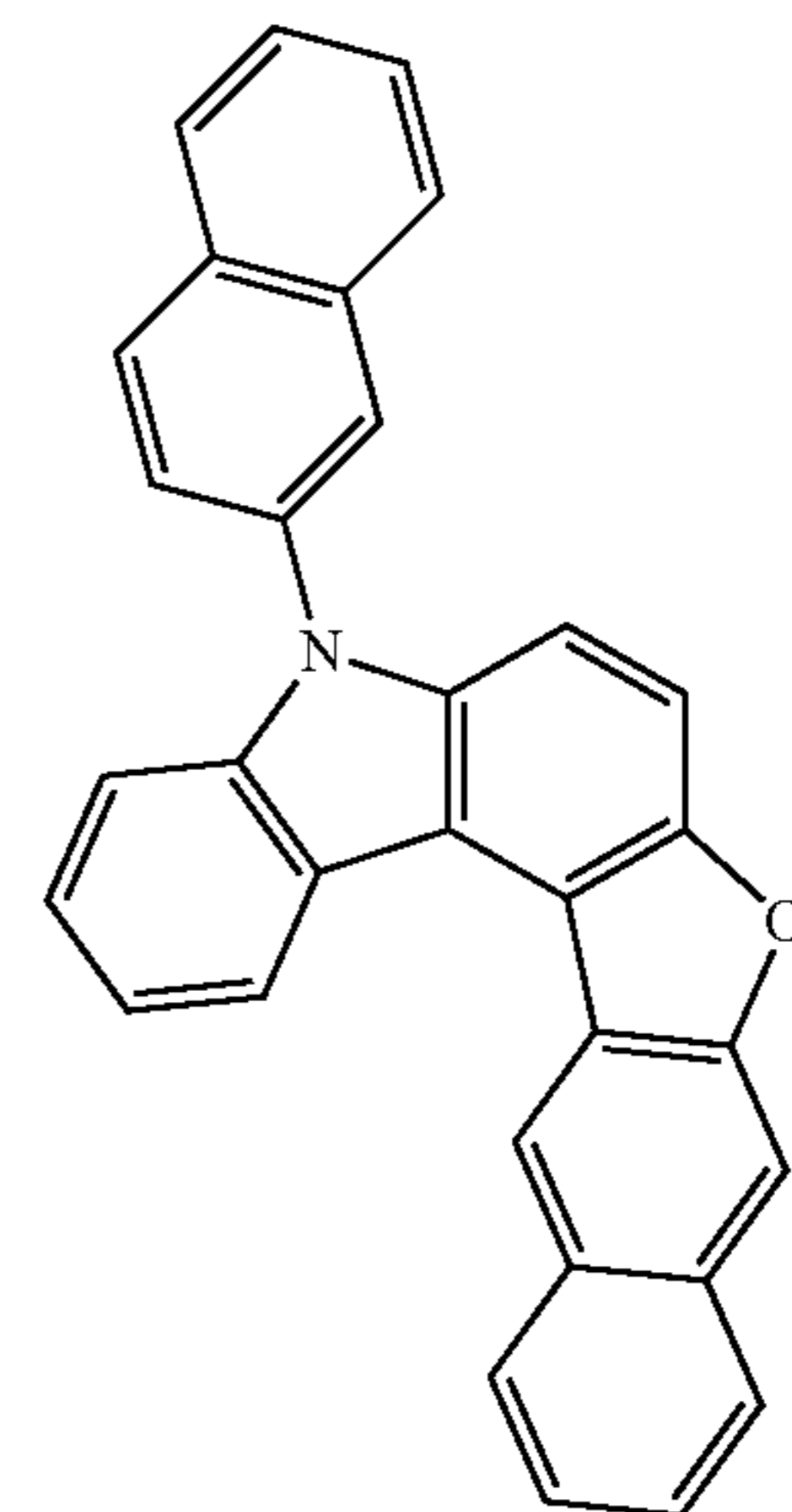
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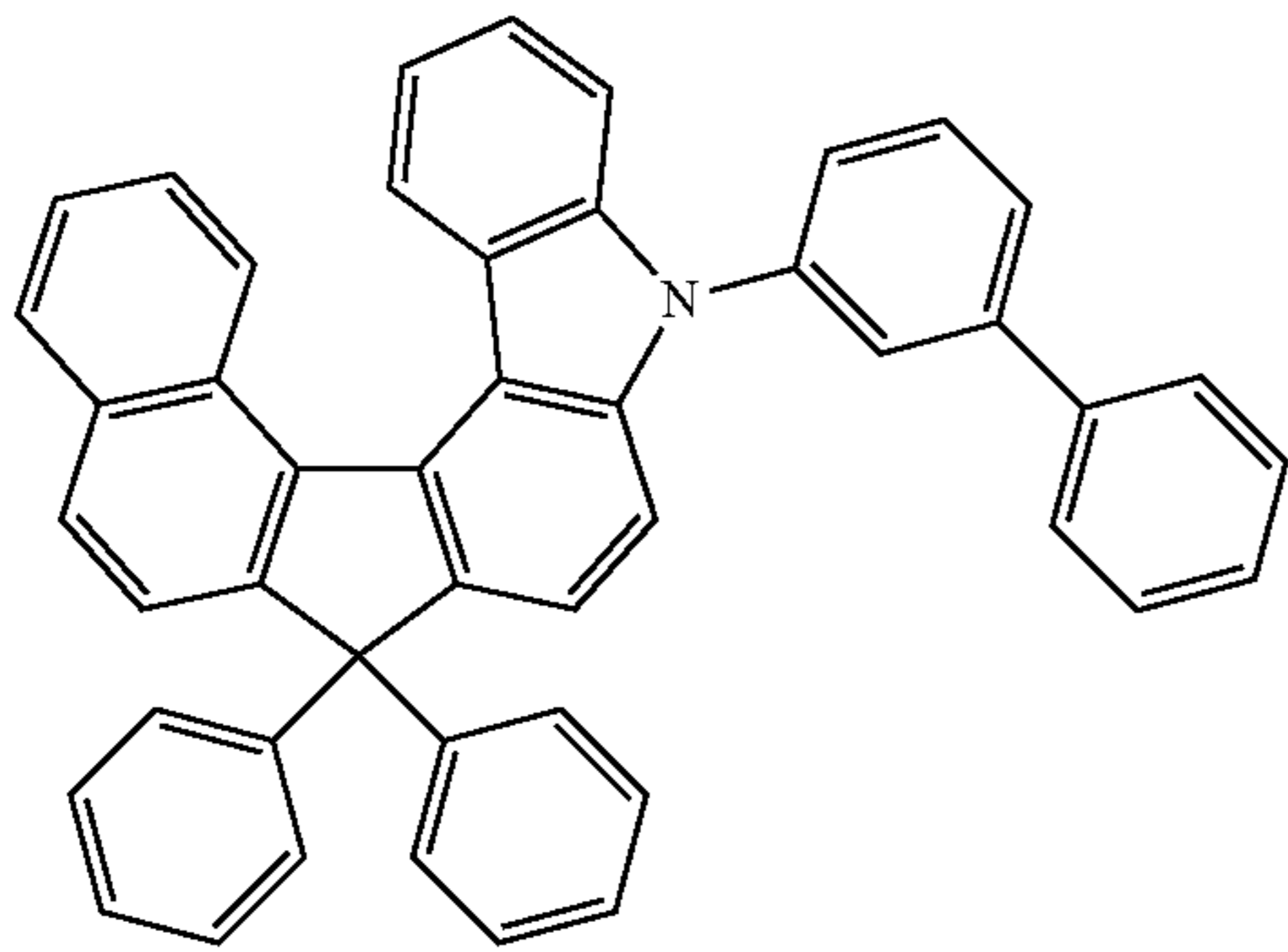


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**229**

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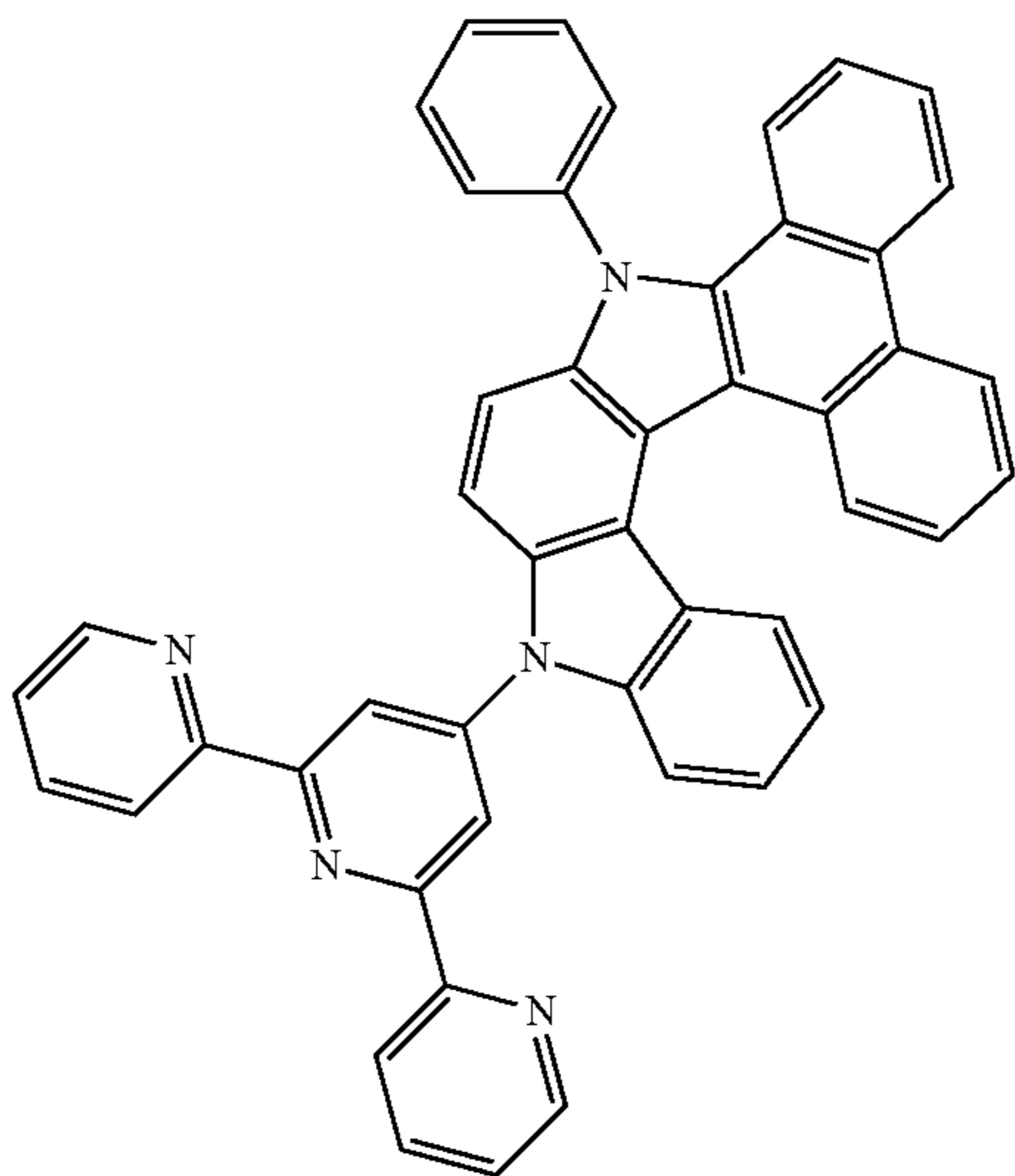
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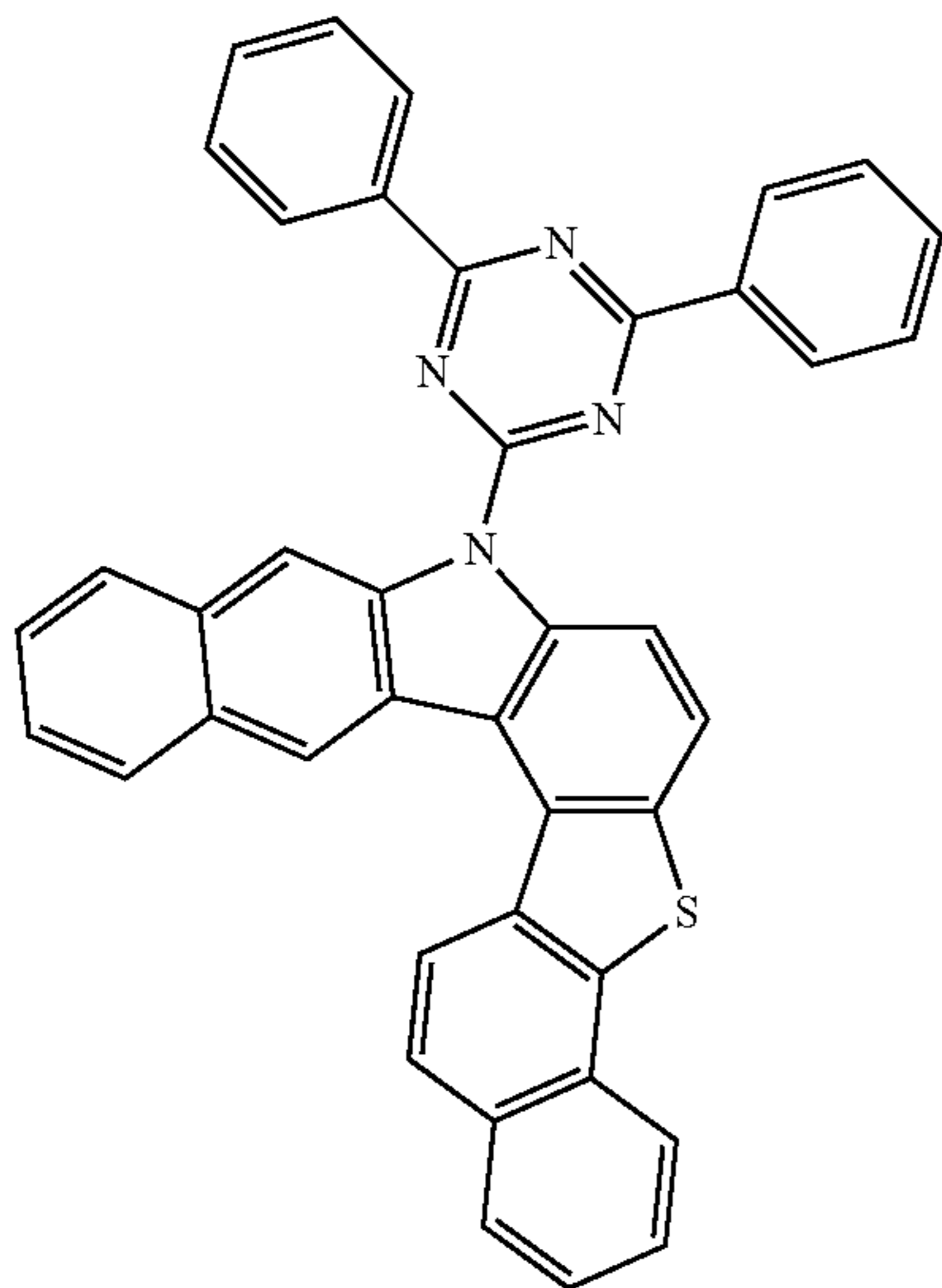
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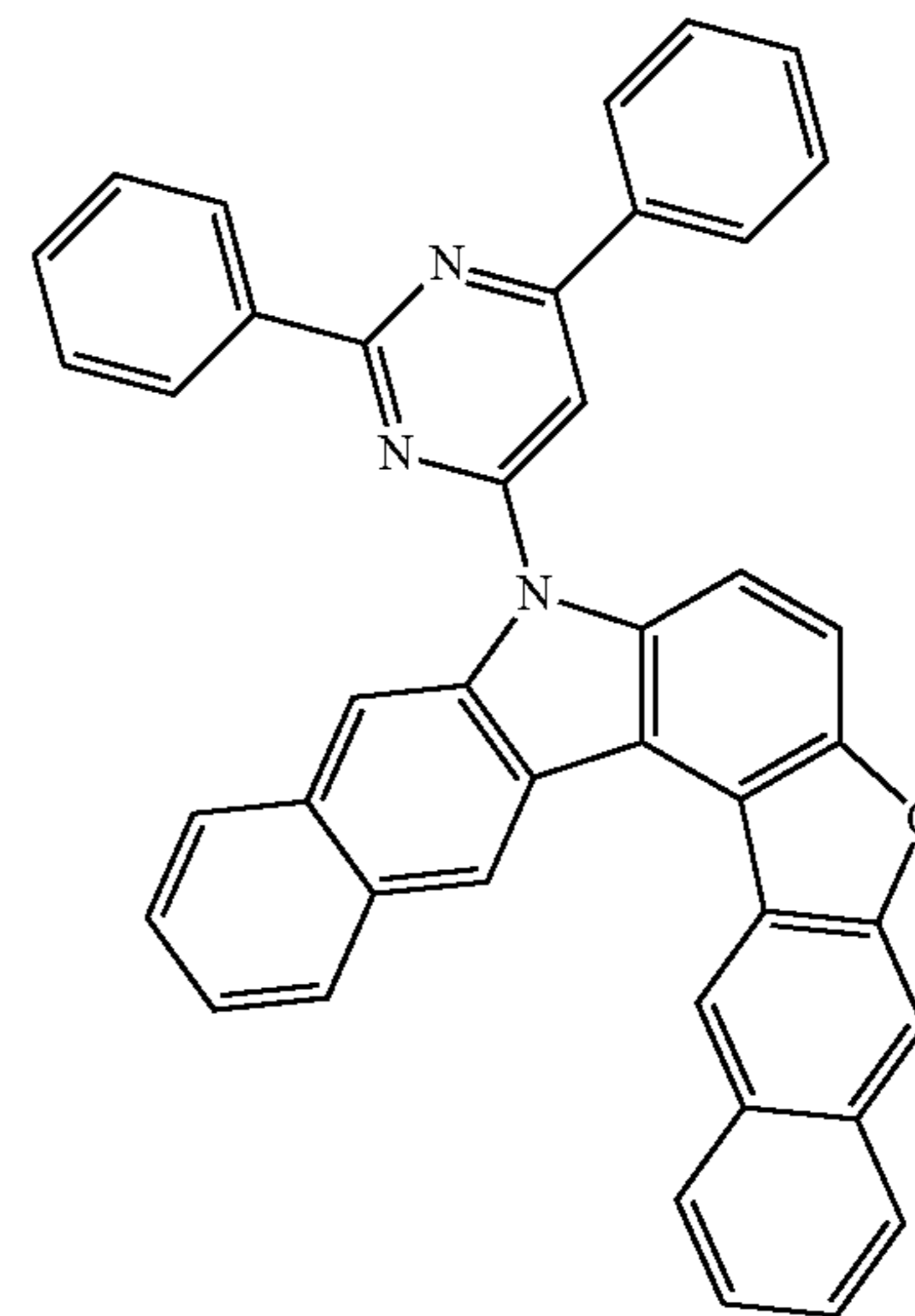
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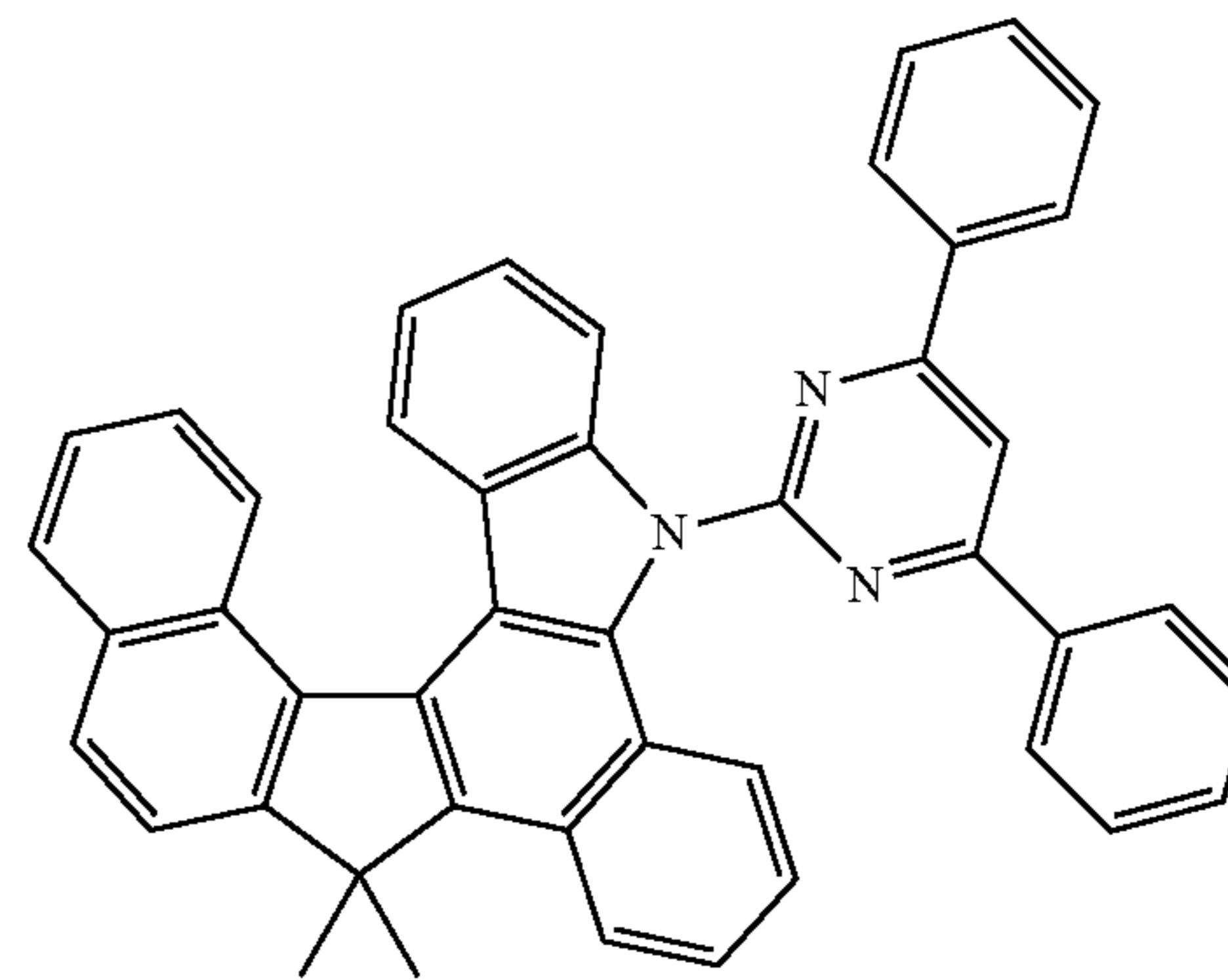
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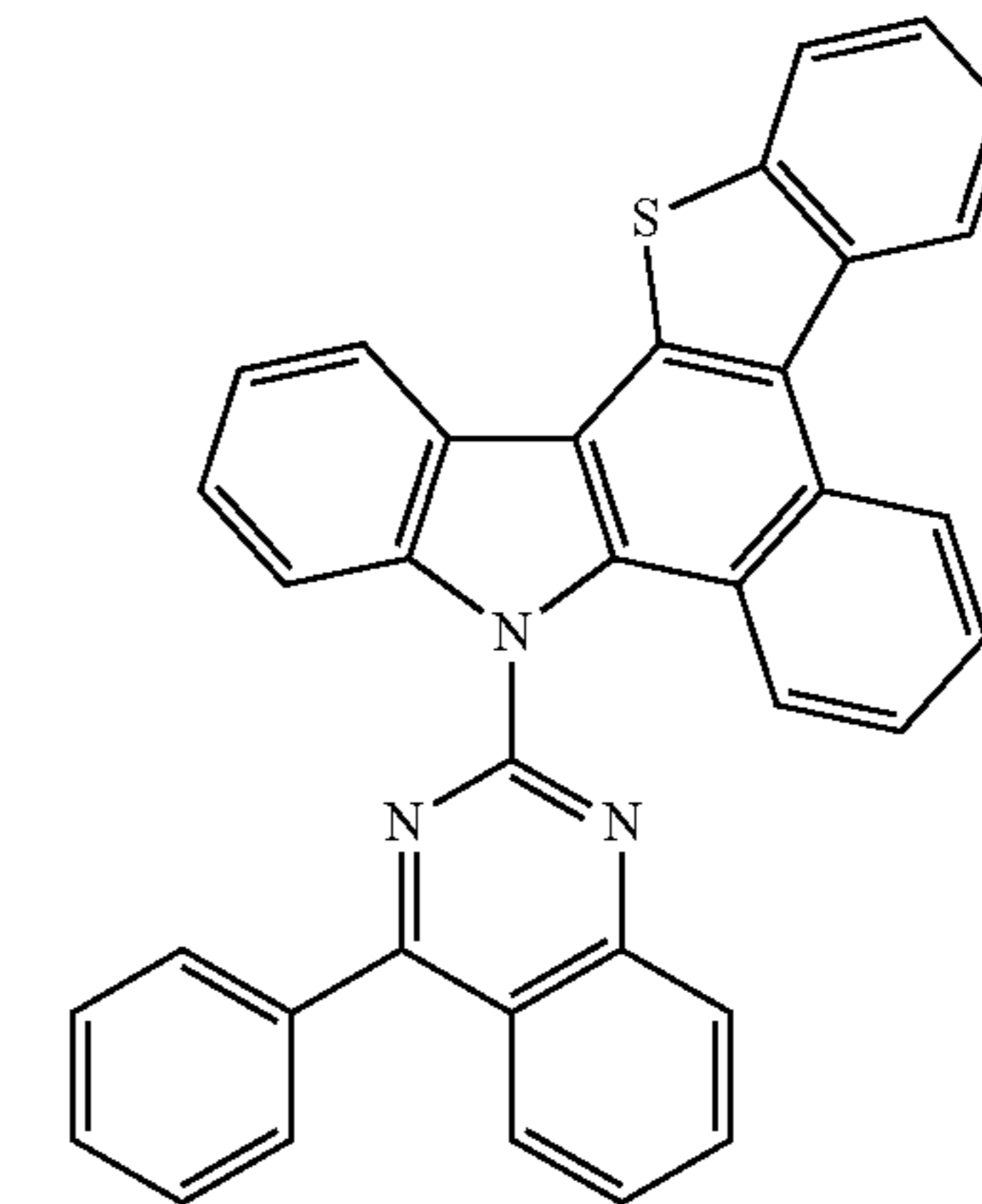
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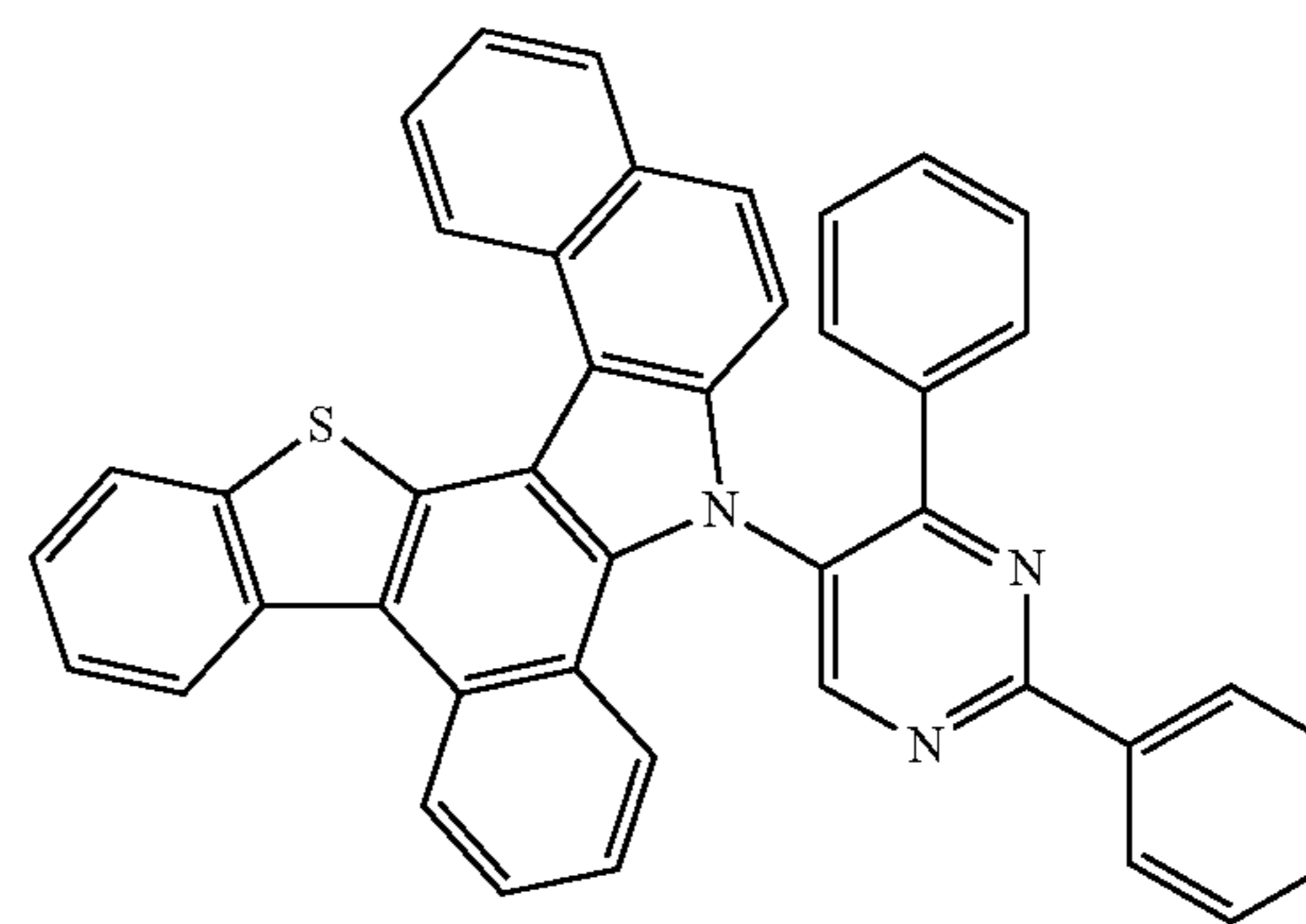
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3-61

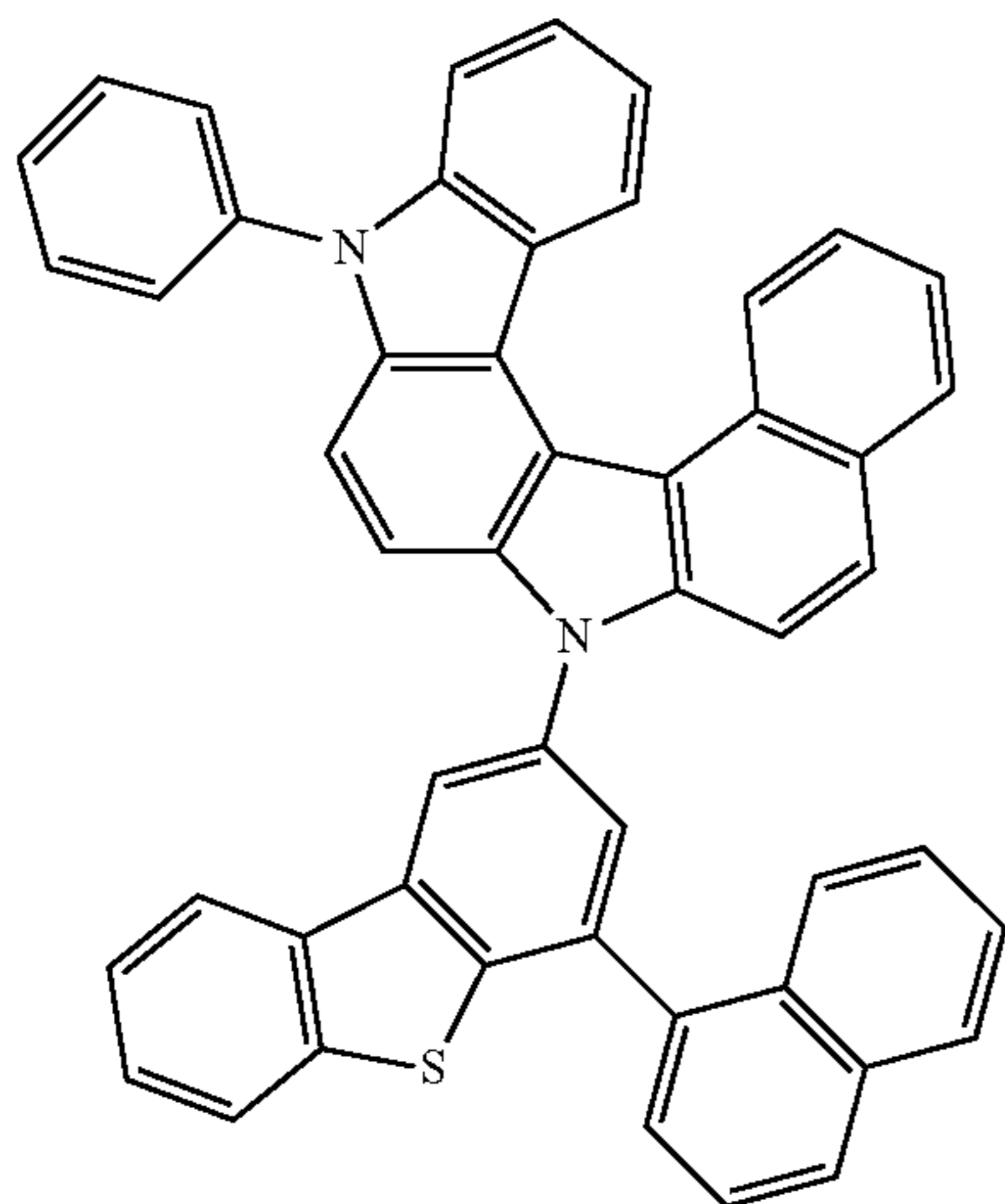
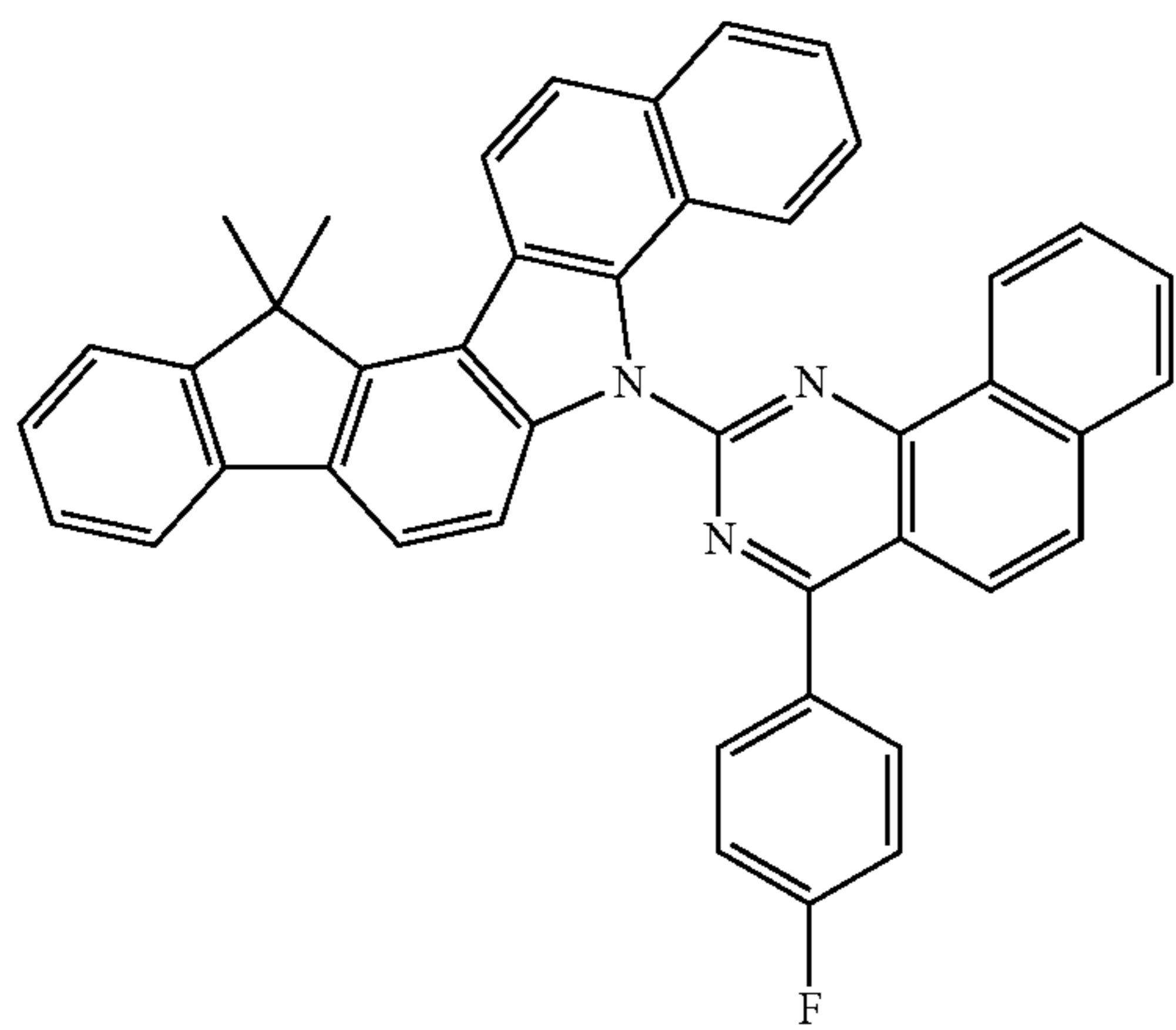
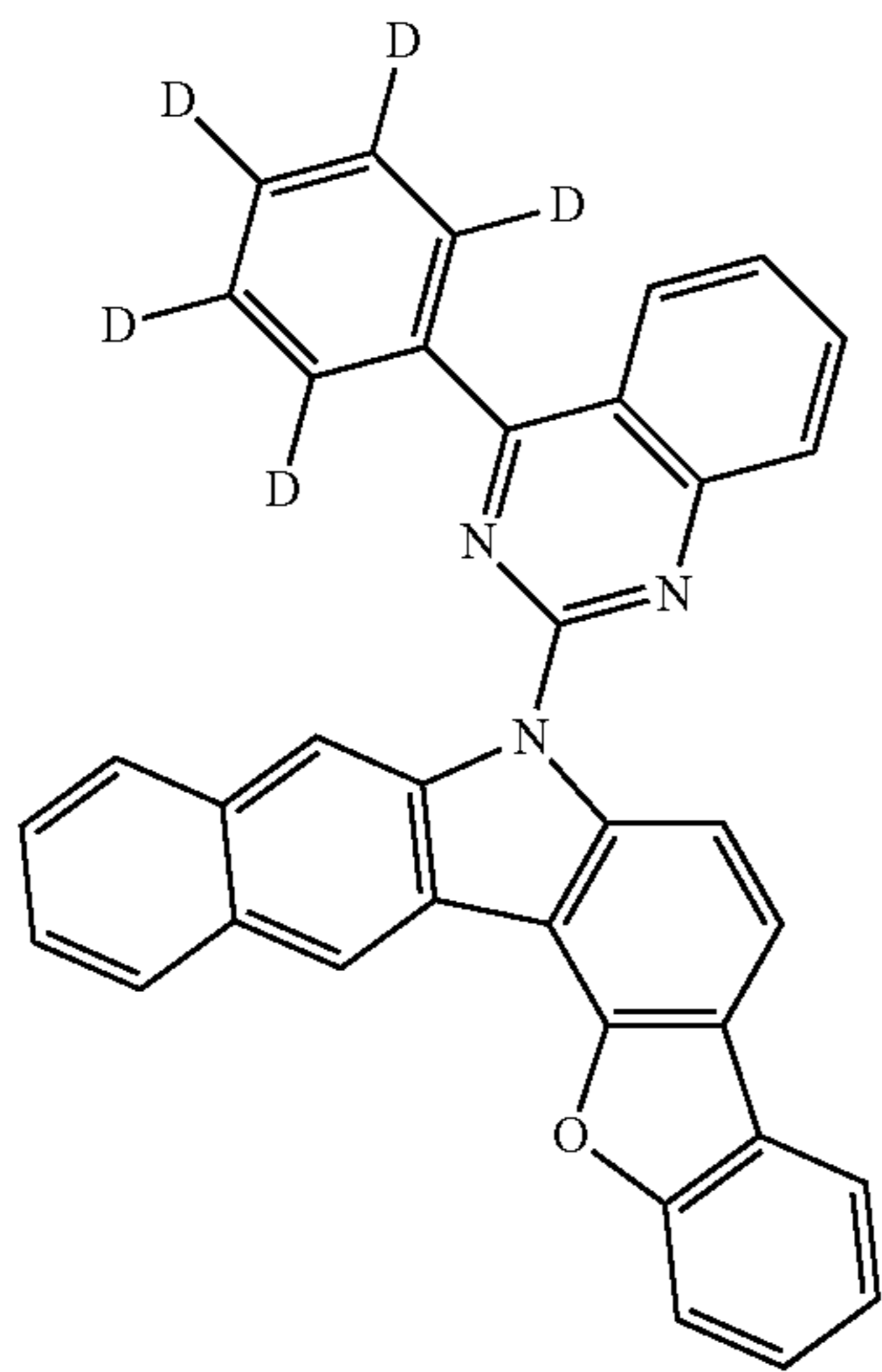


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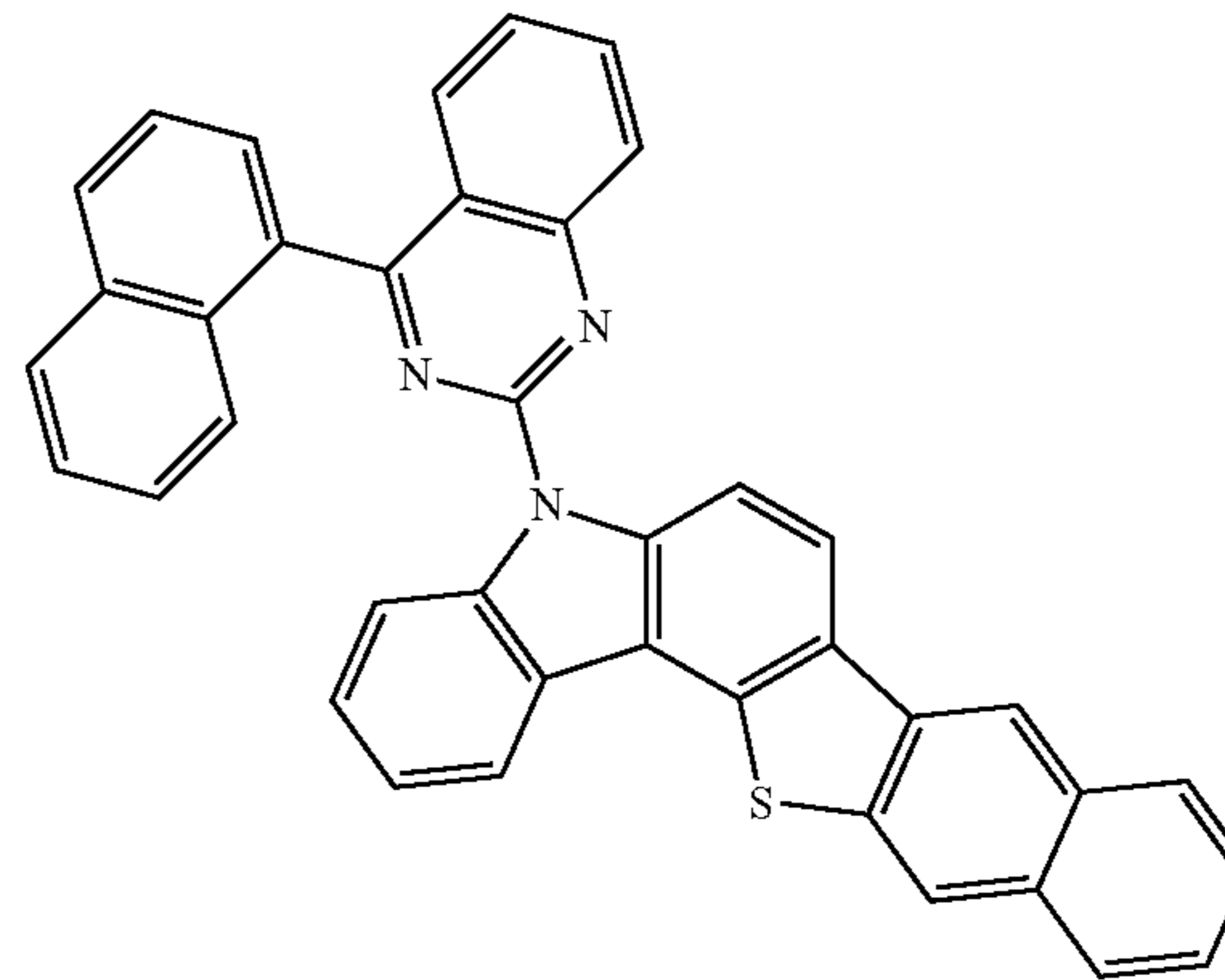
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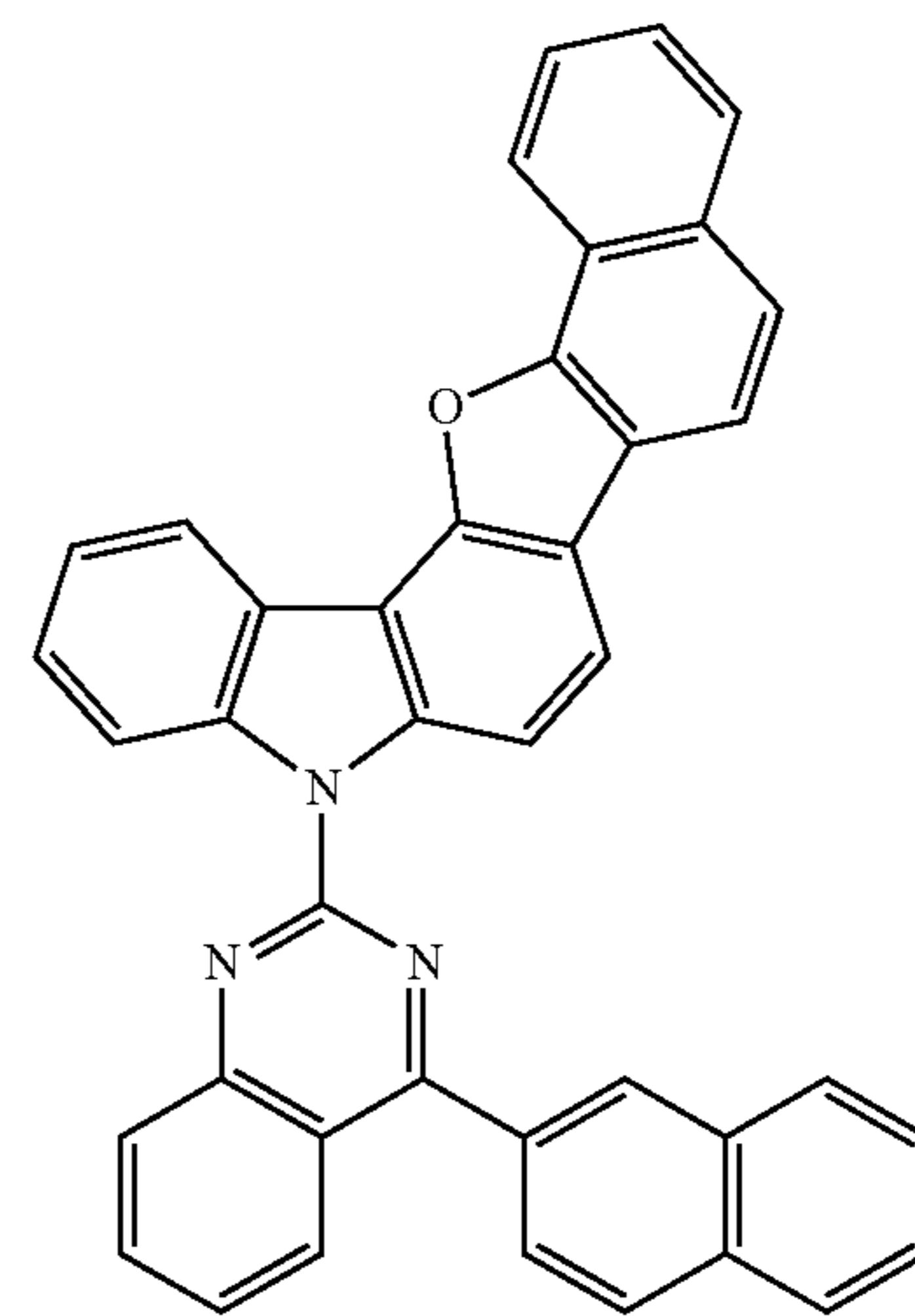
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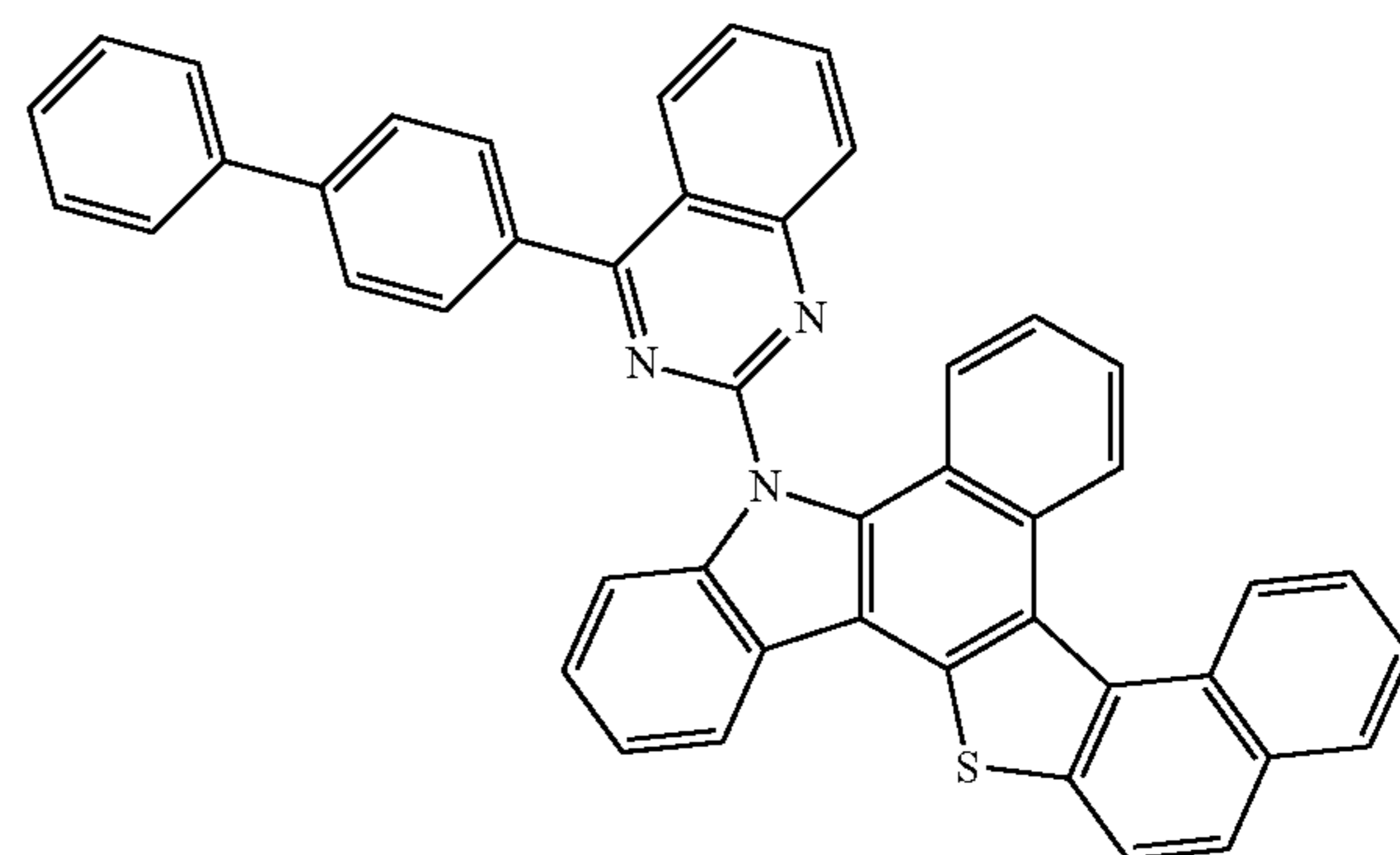
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3-67



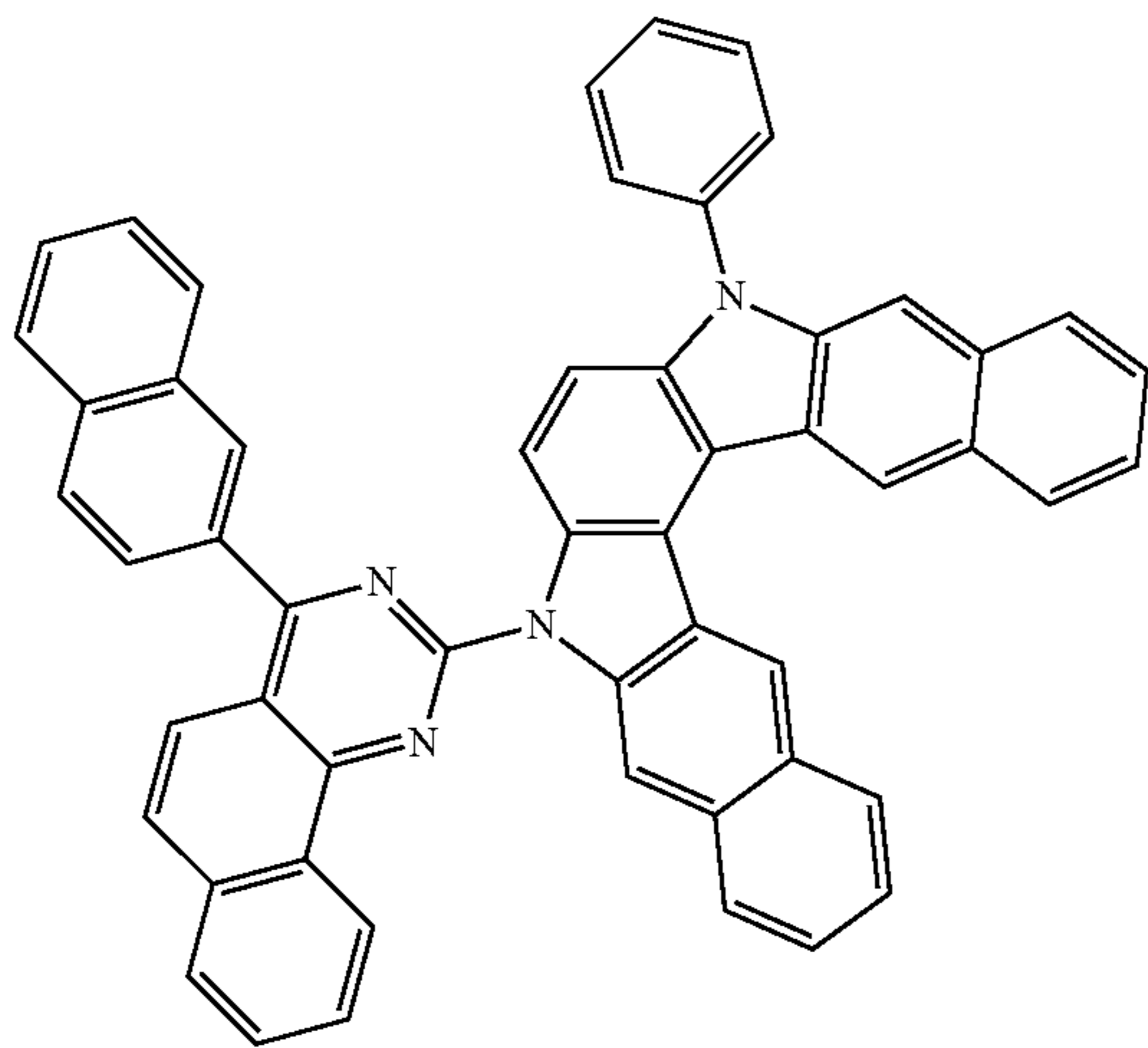
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**233**

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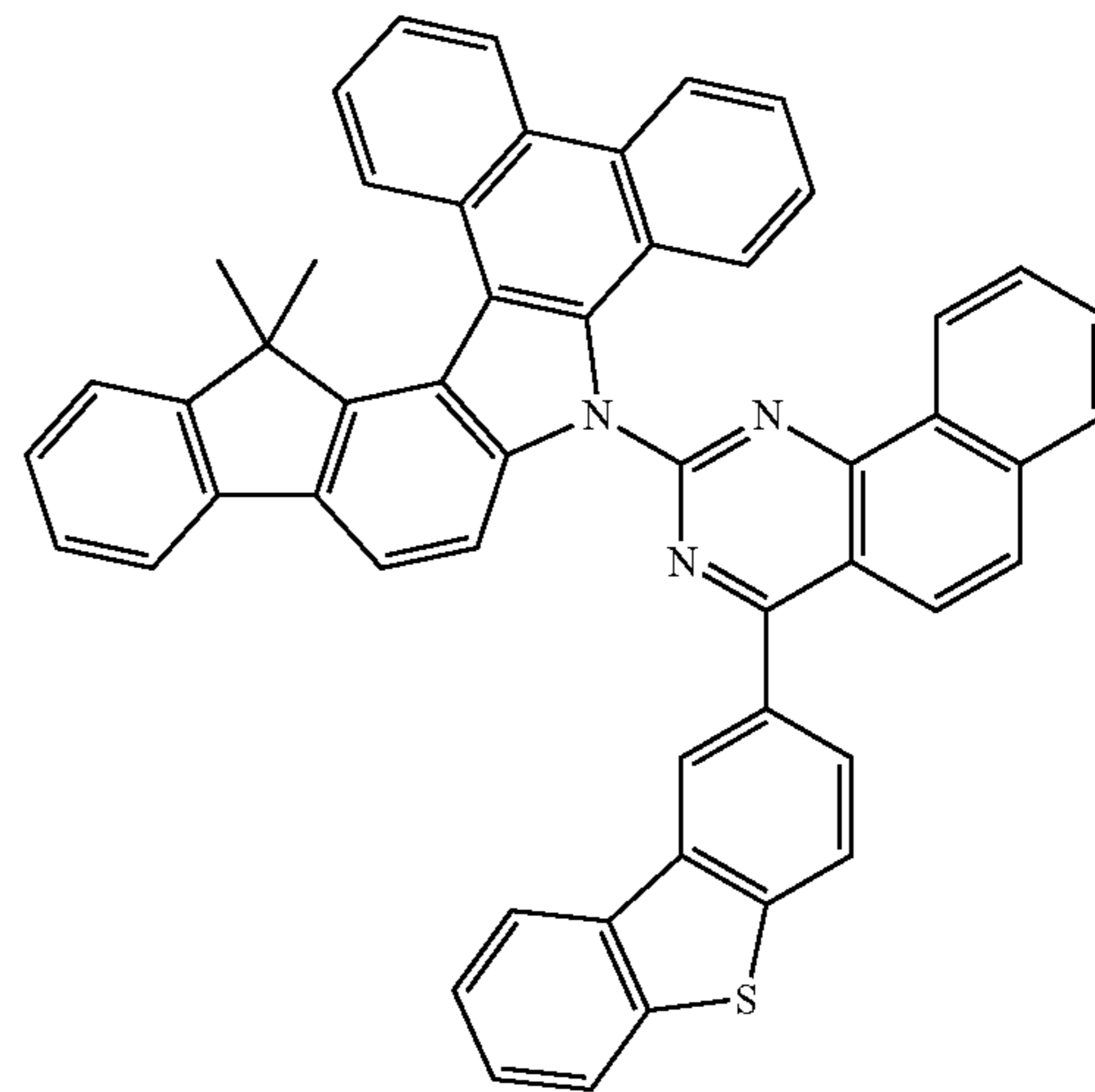
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**234**

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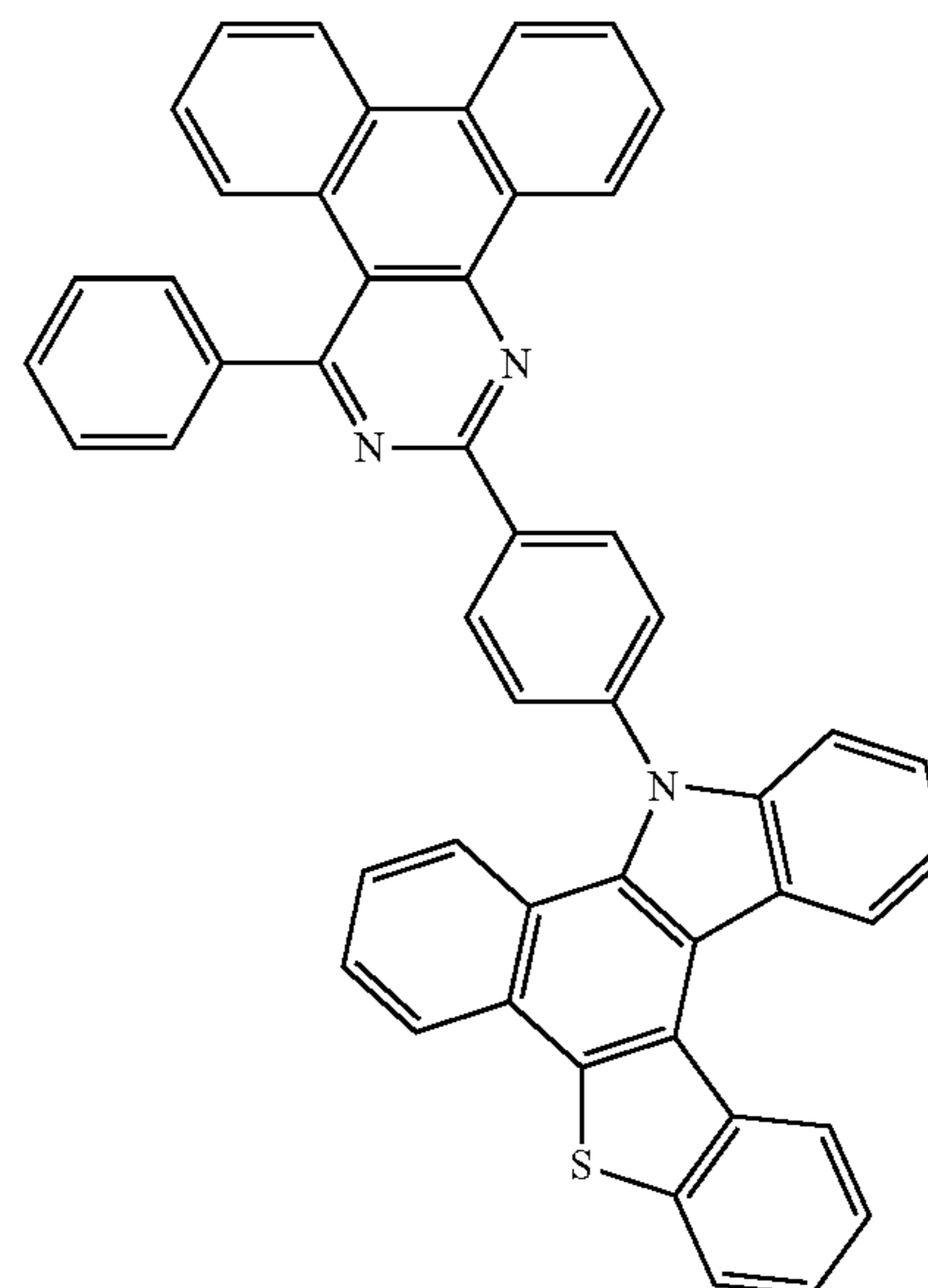
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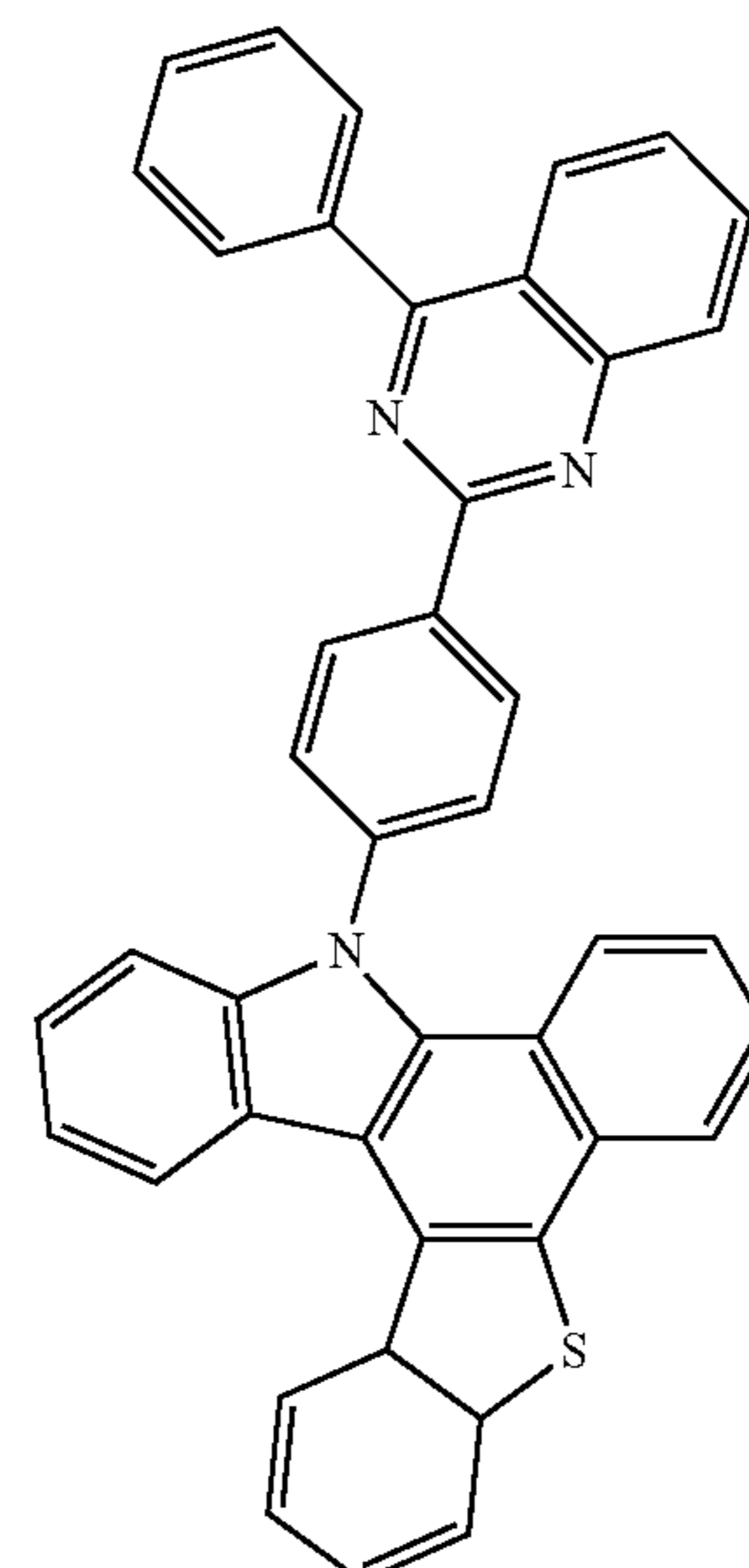
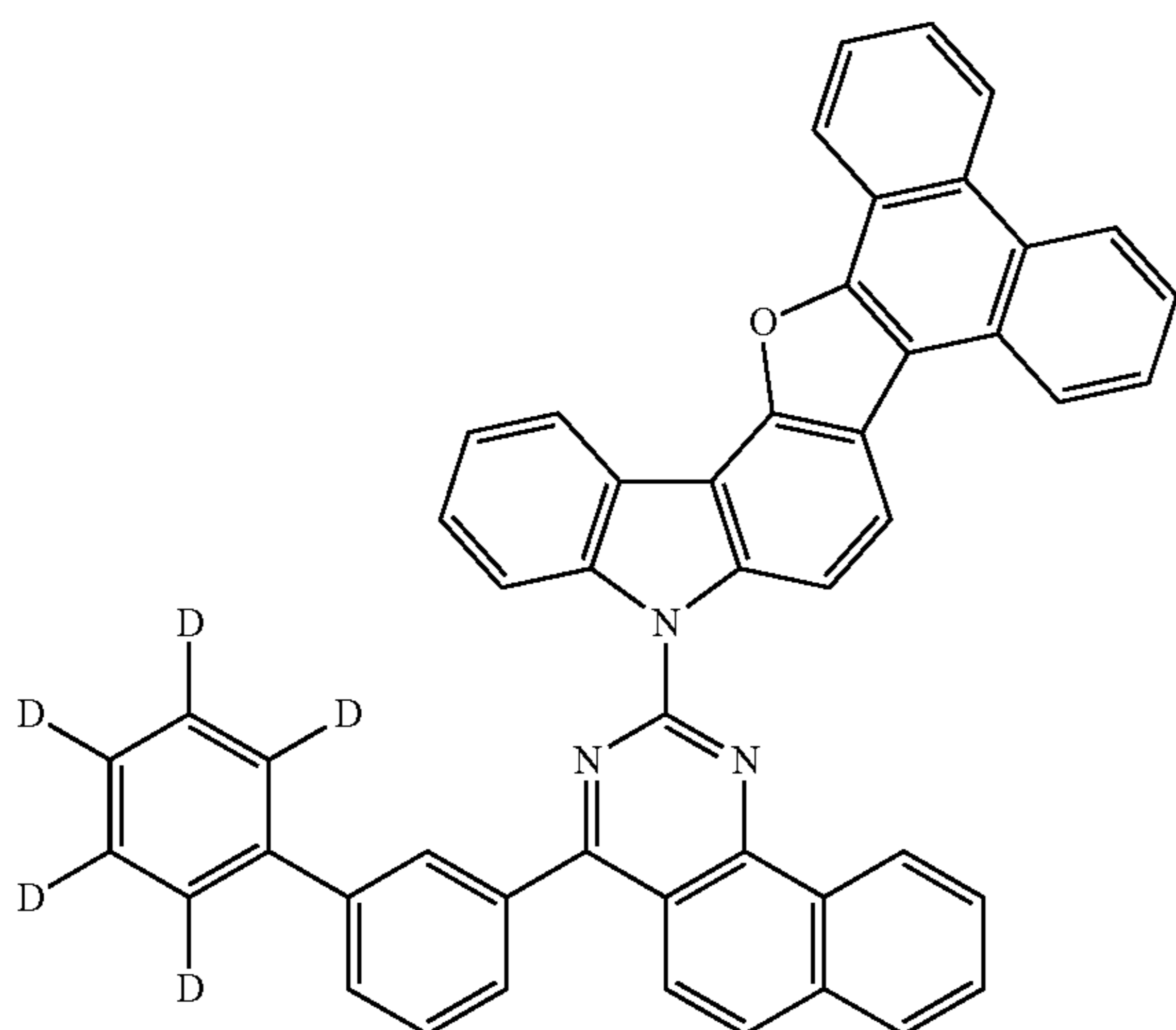
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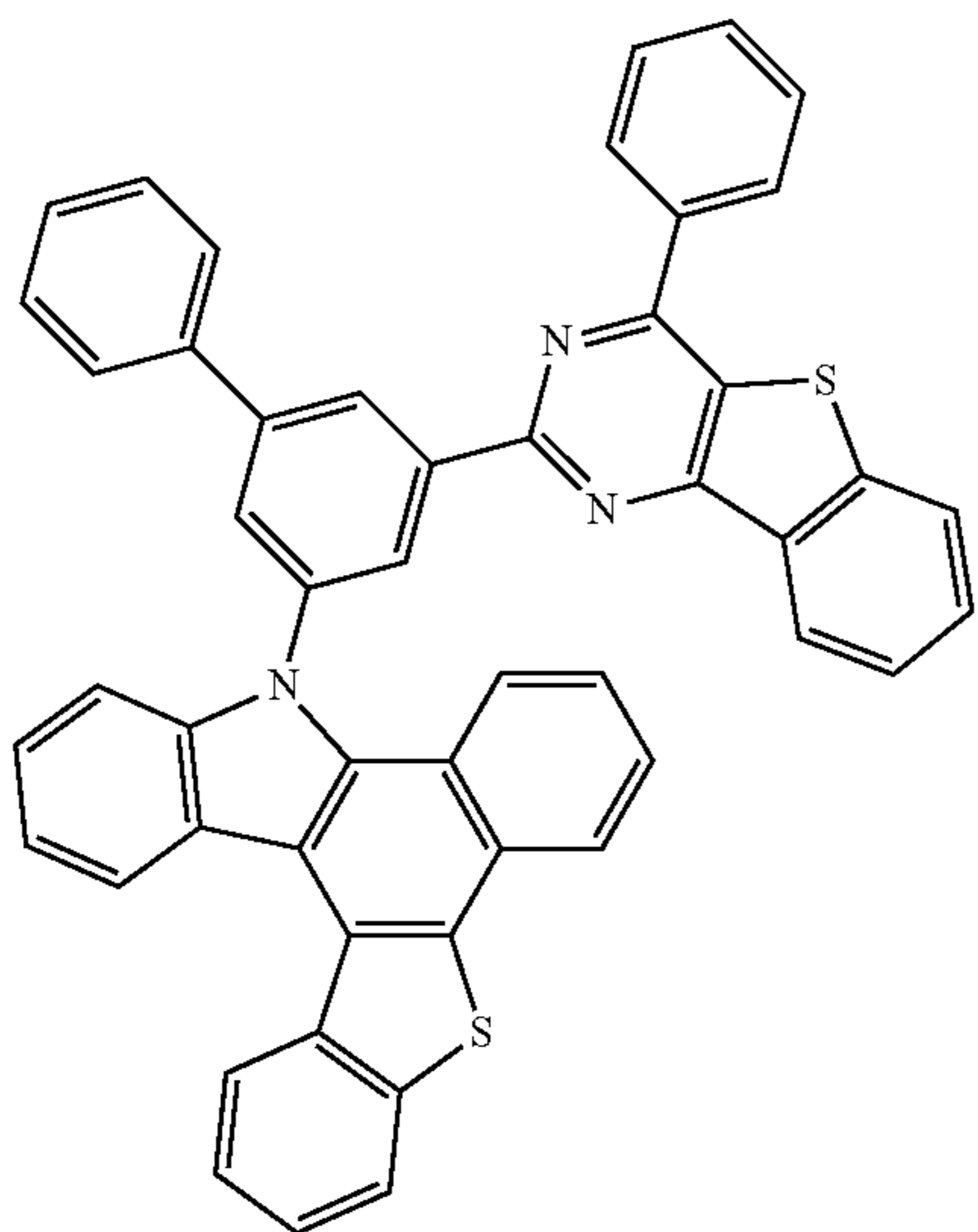
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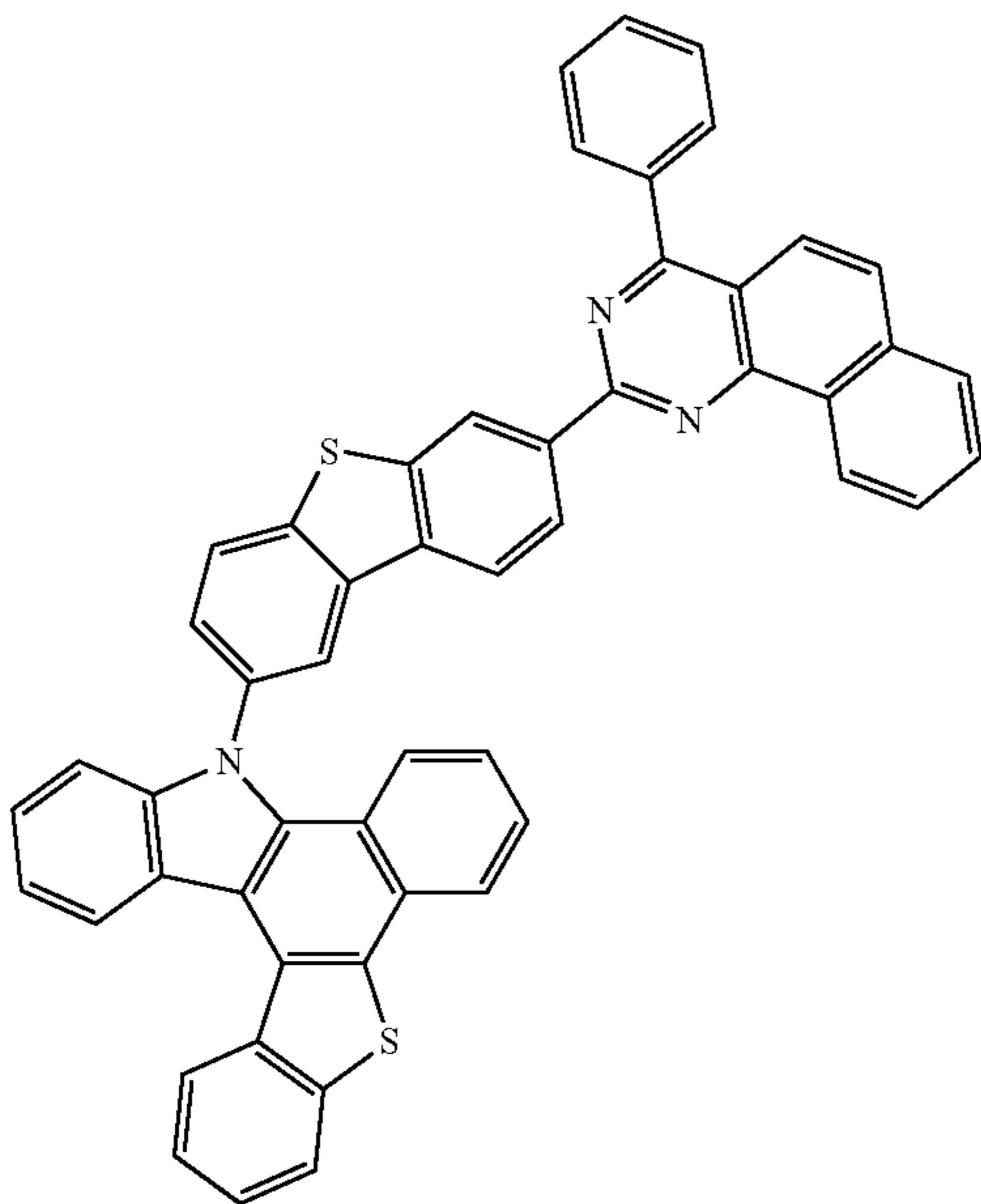
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3-76



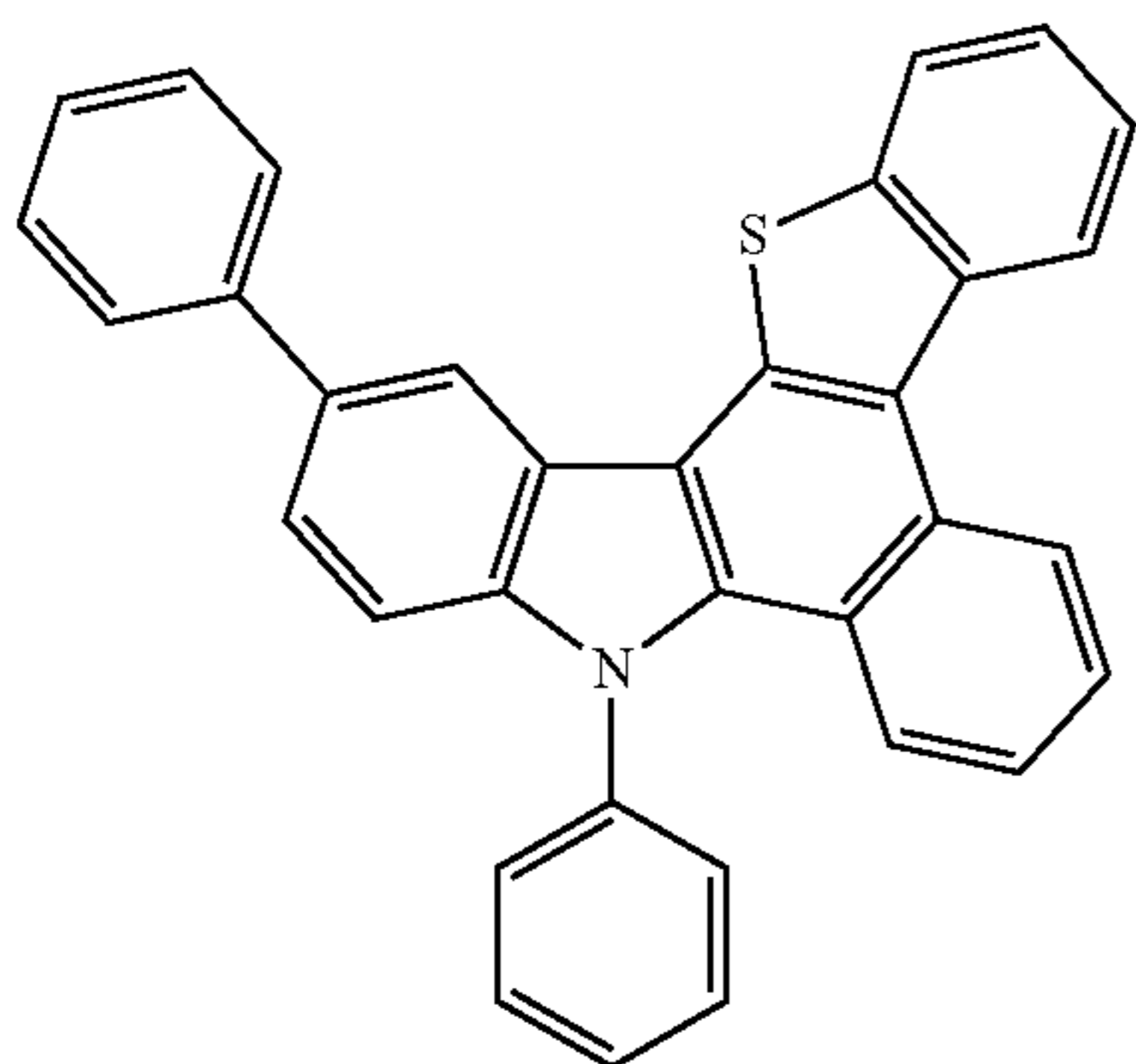
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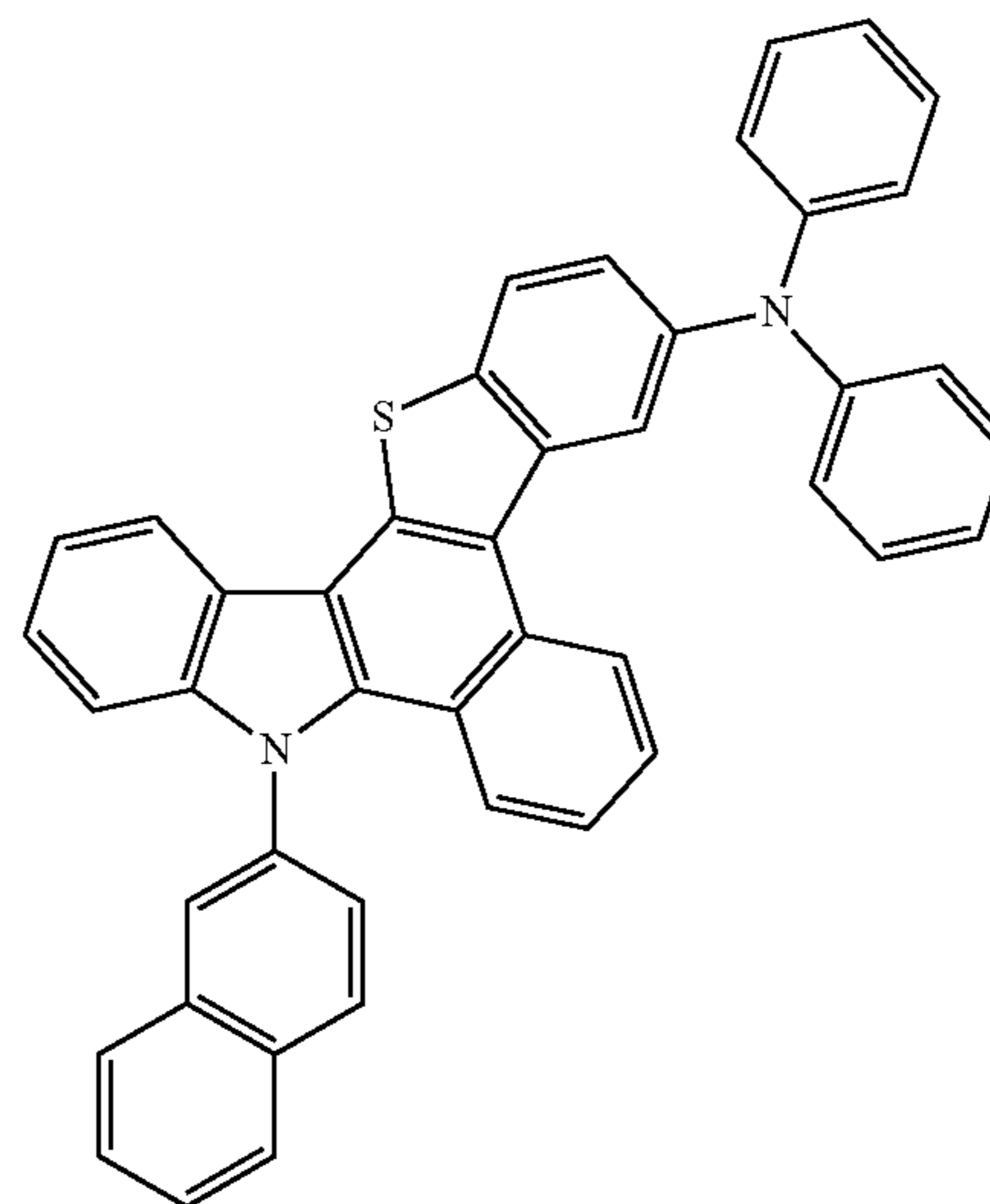
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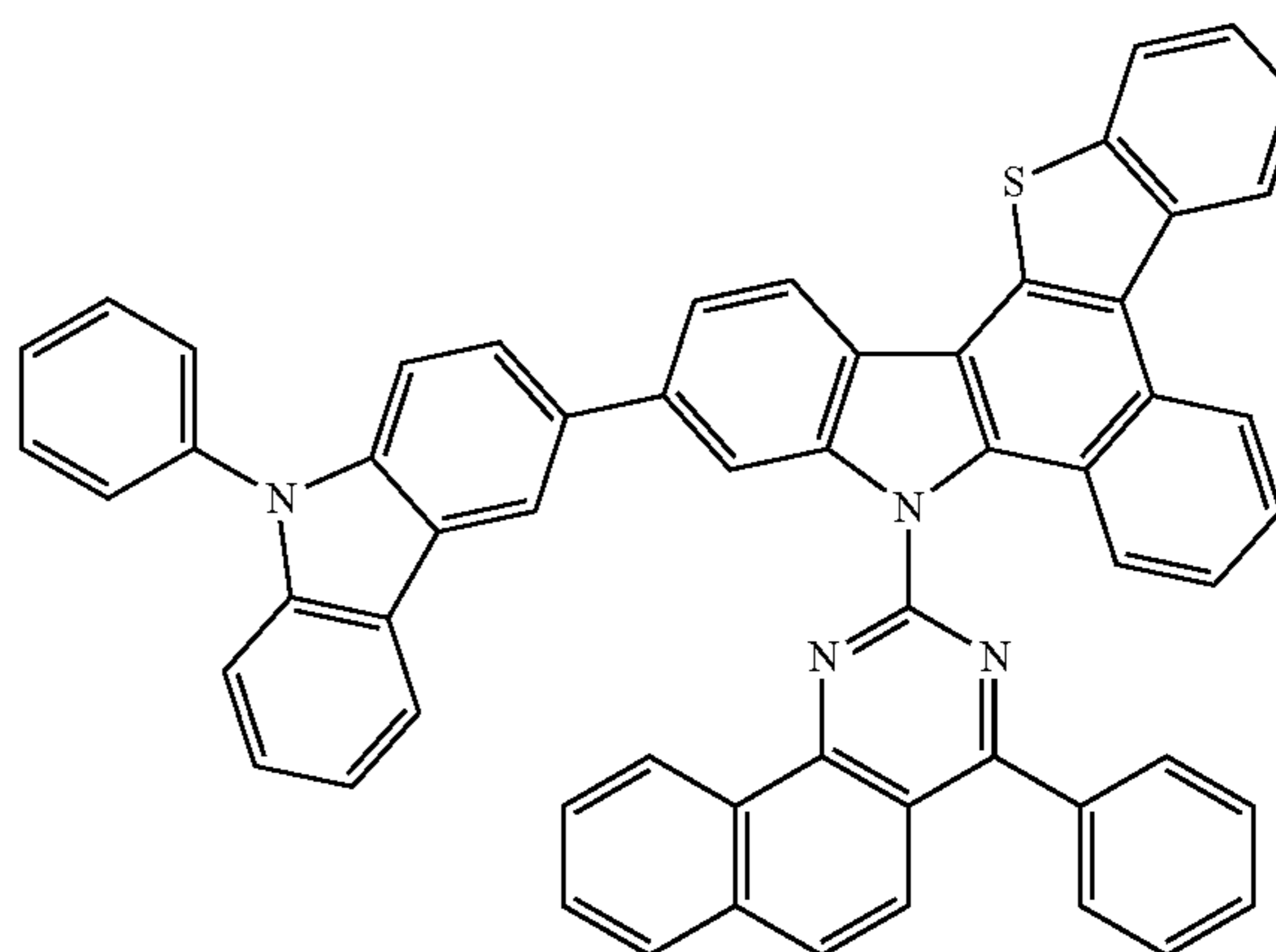
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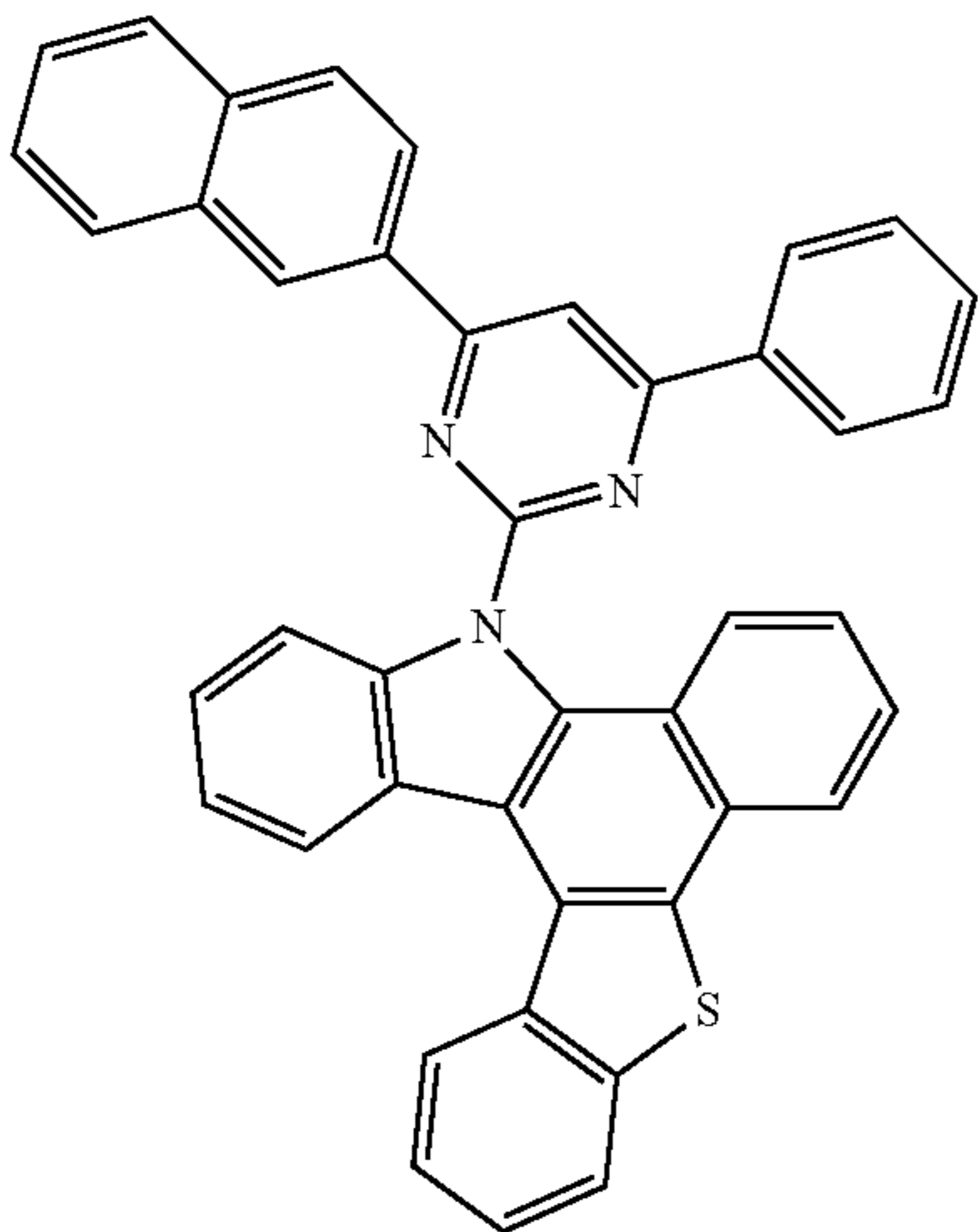
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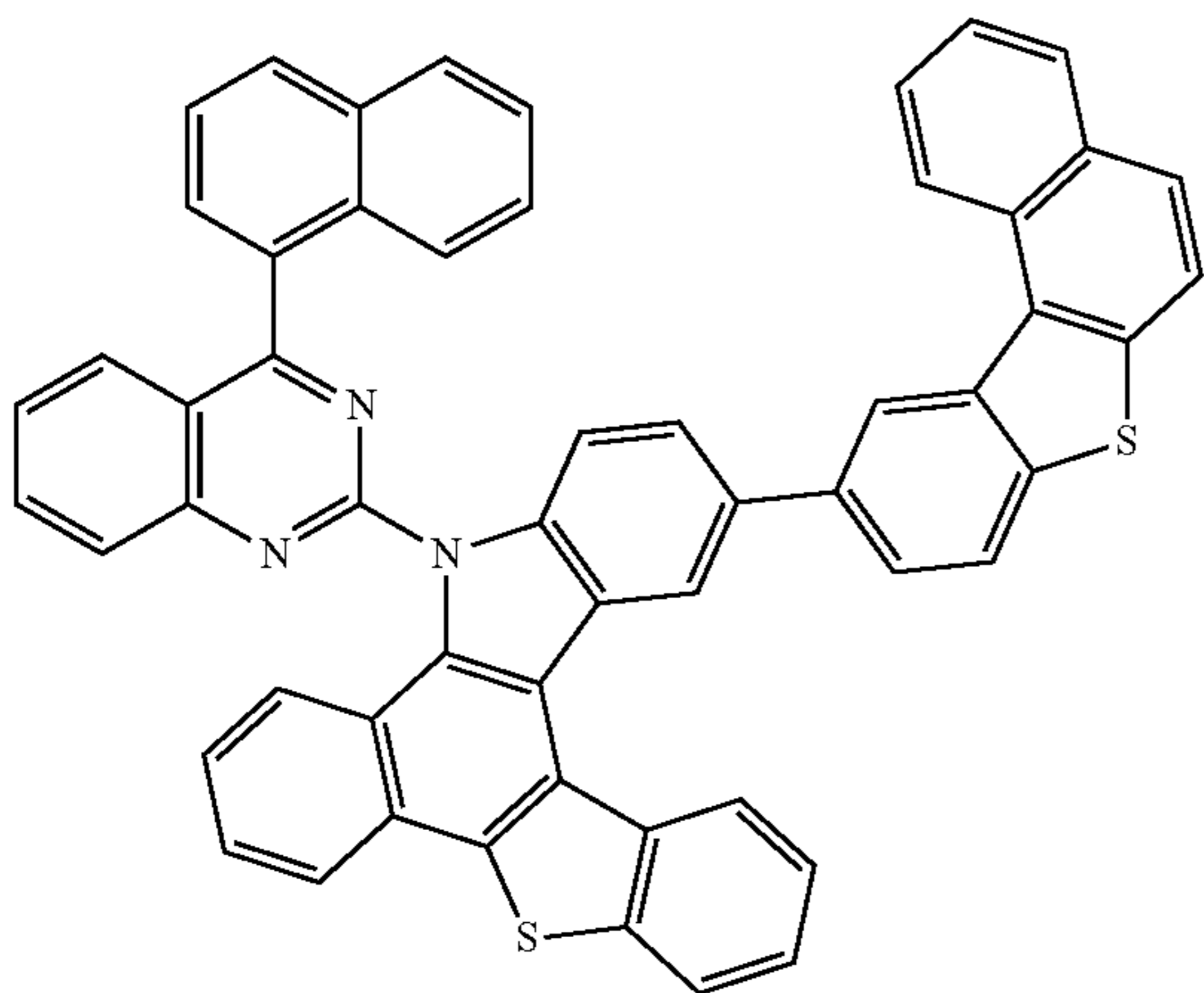
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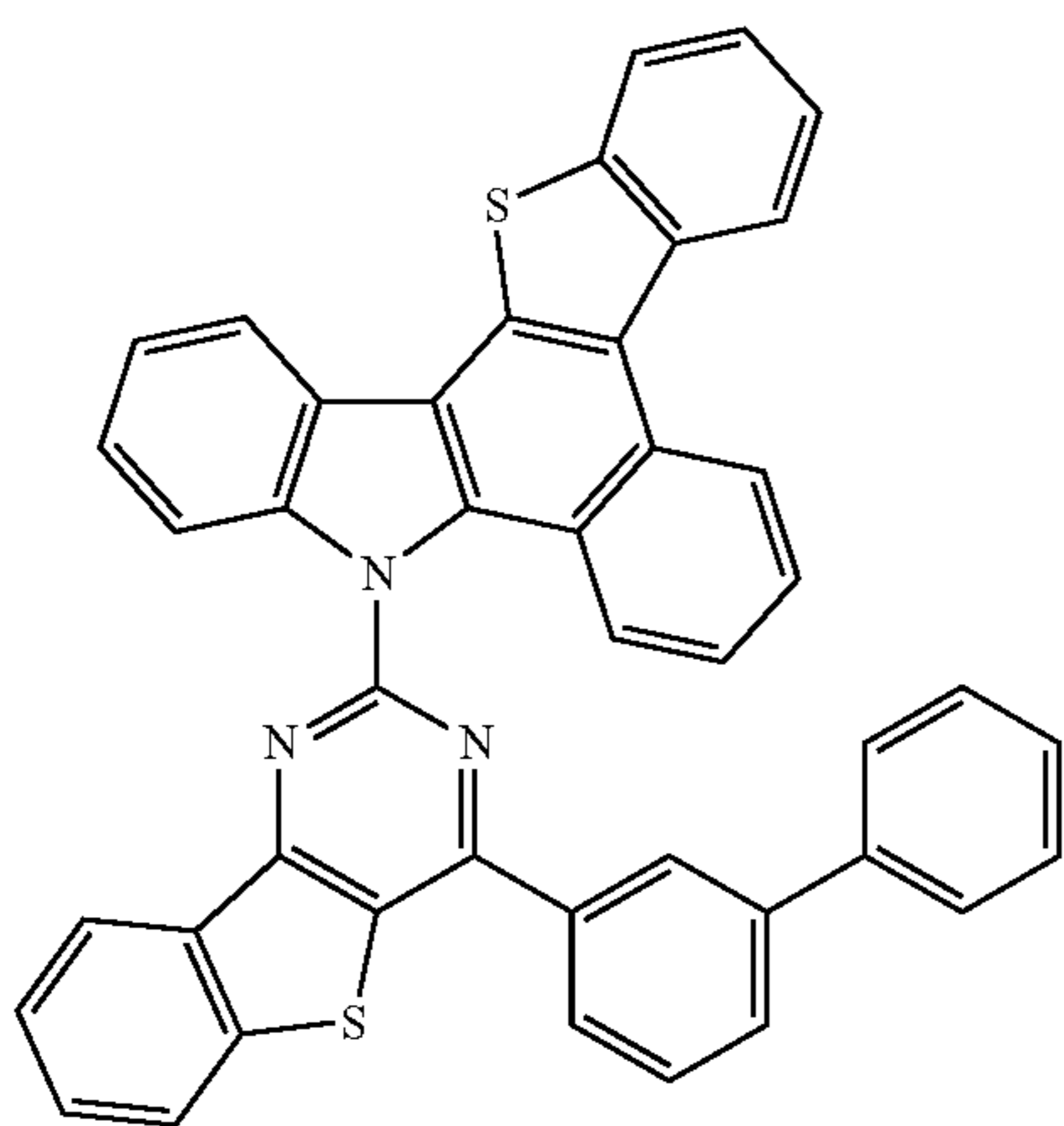
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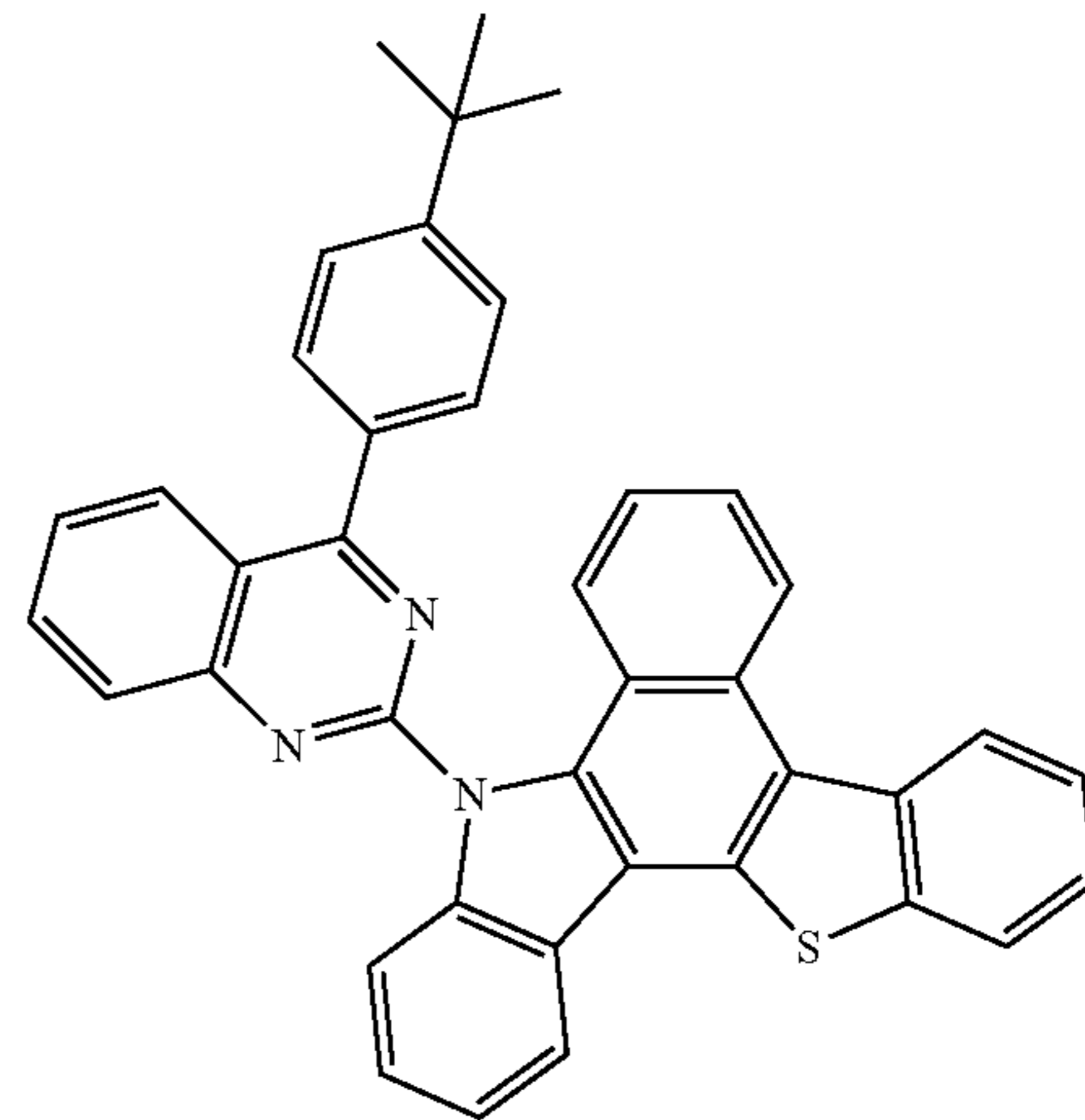
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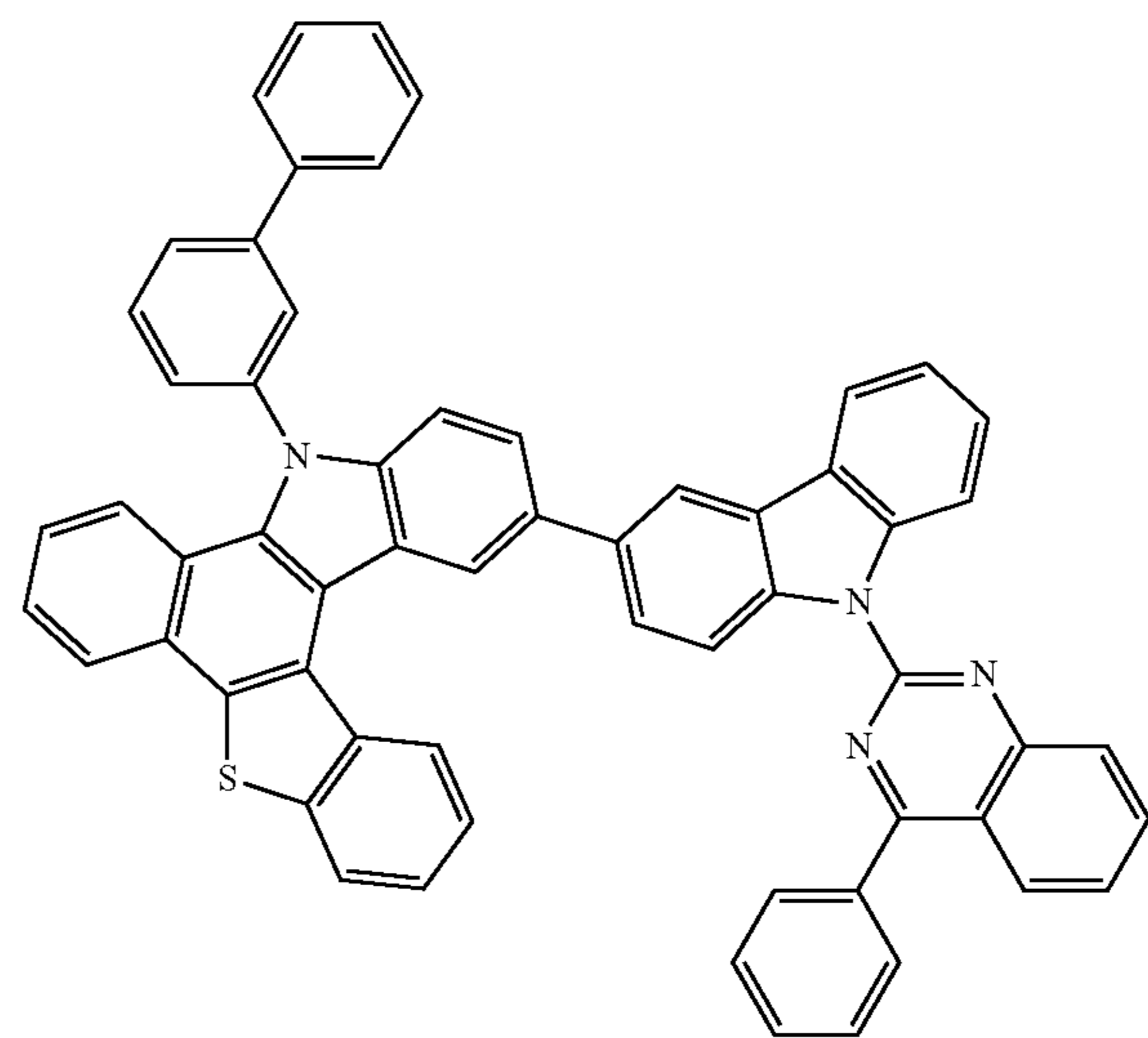


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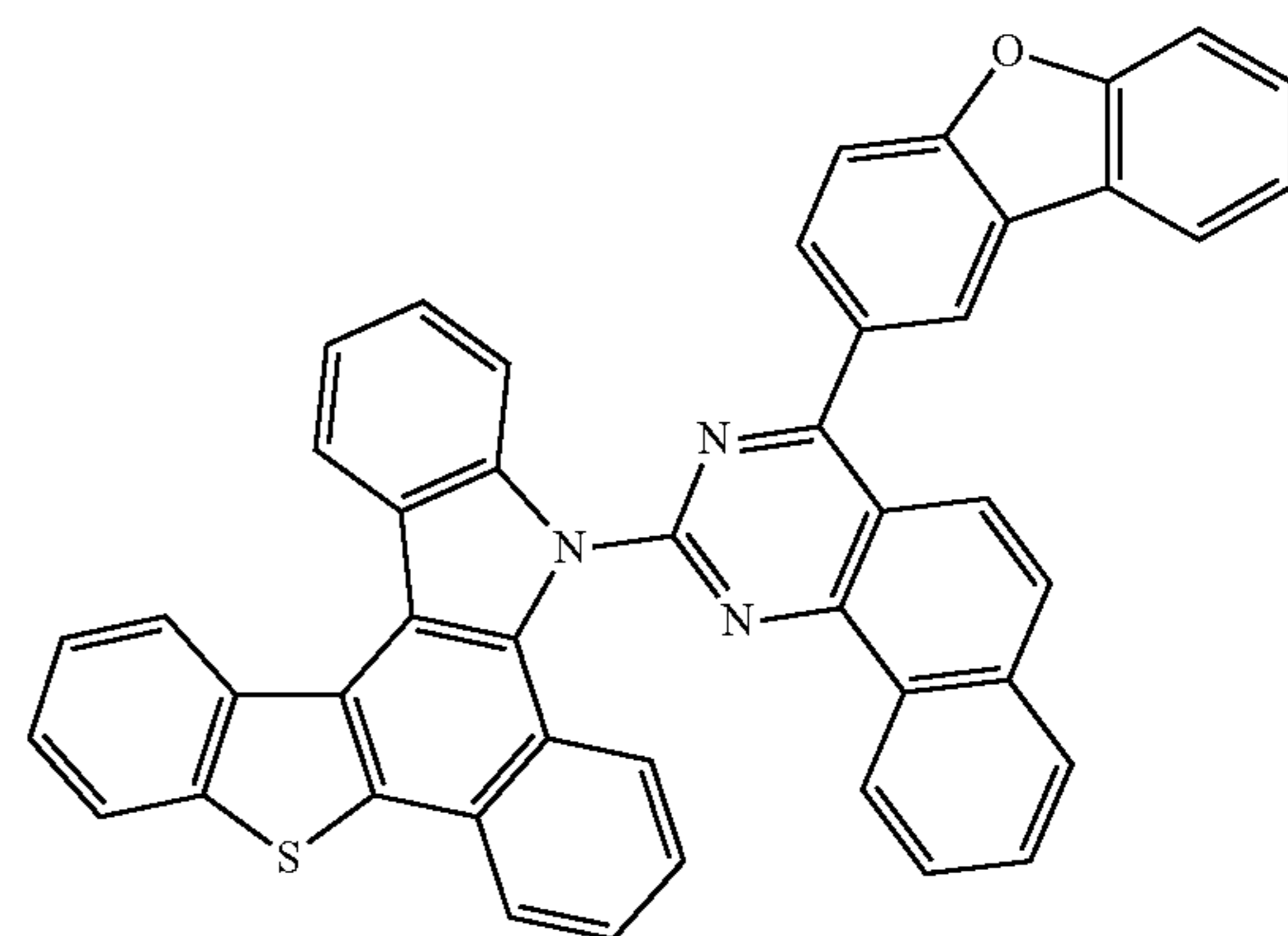
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3-84



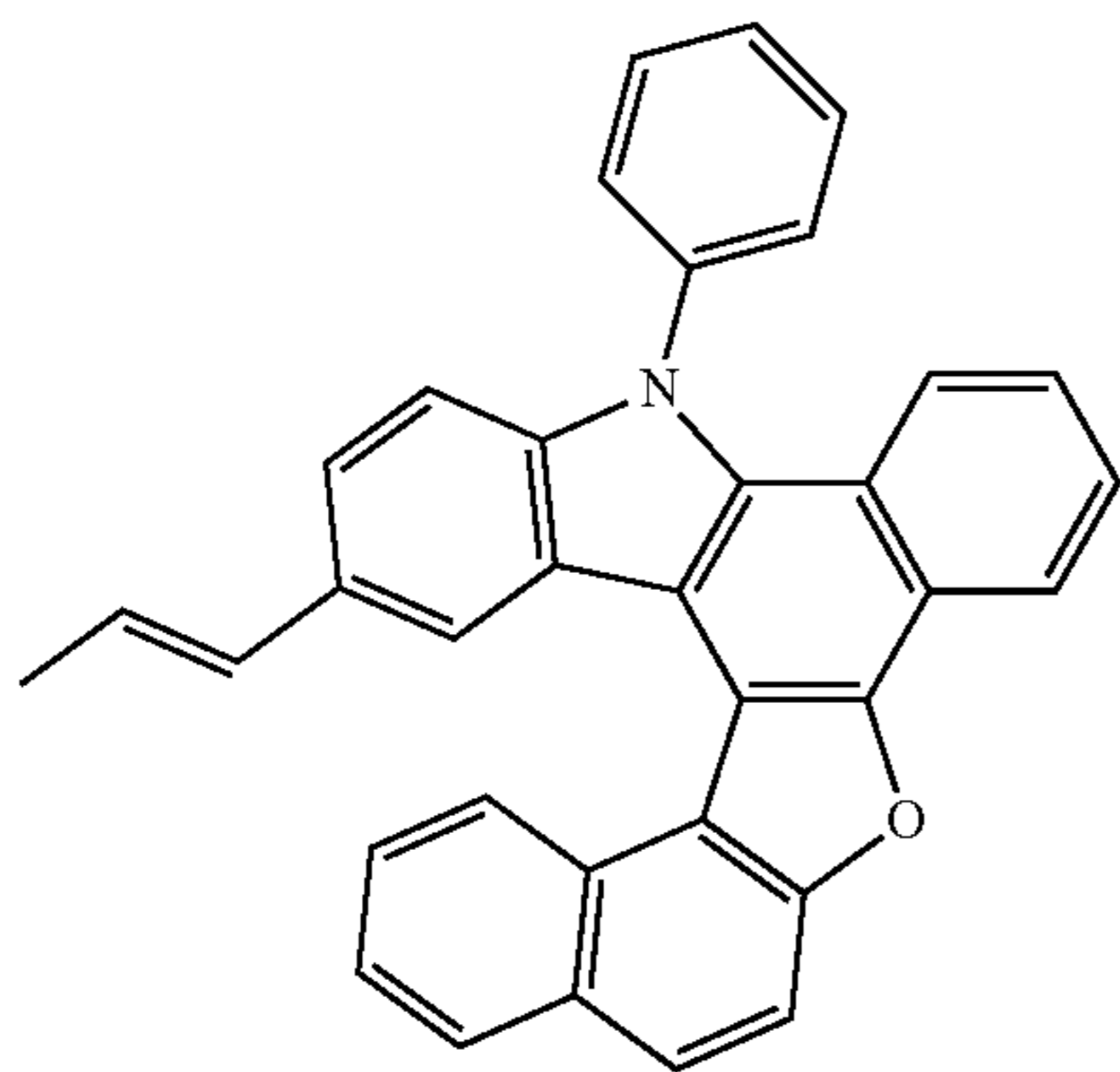
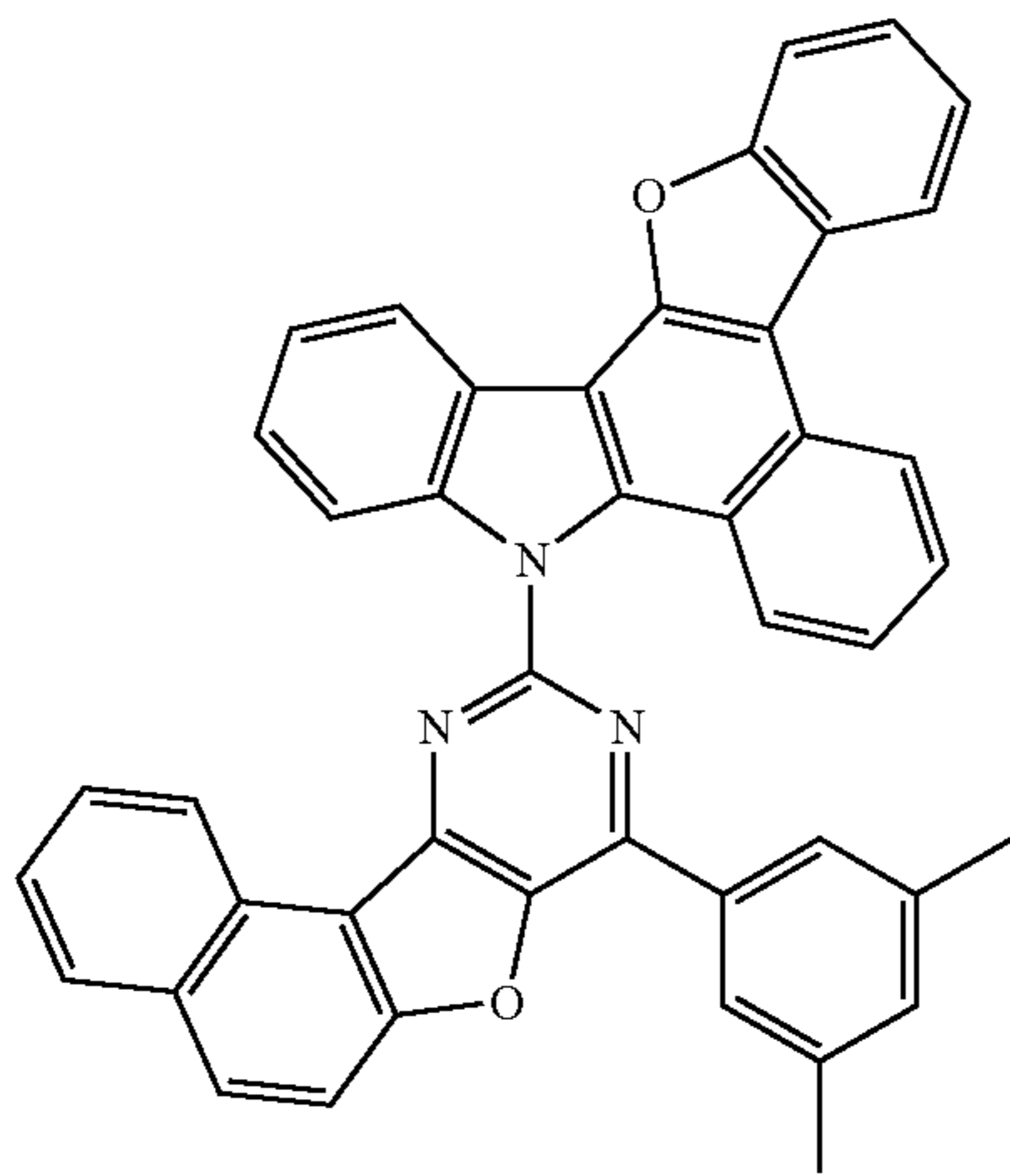
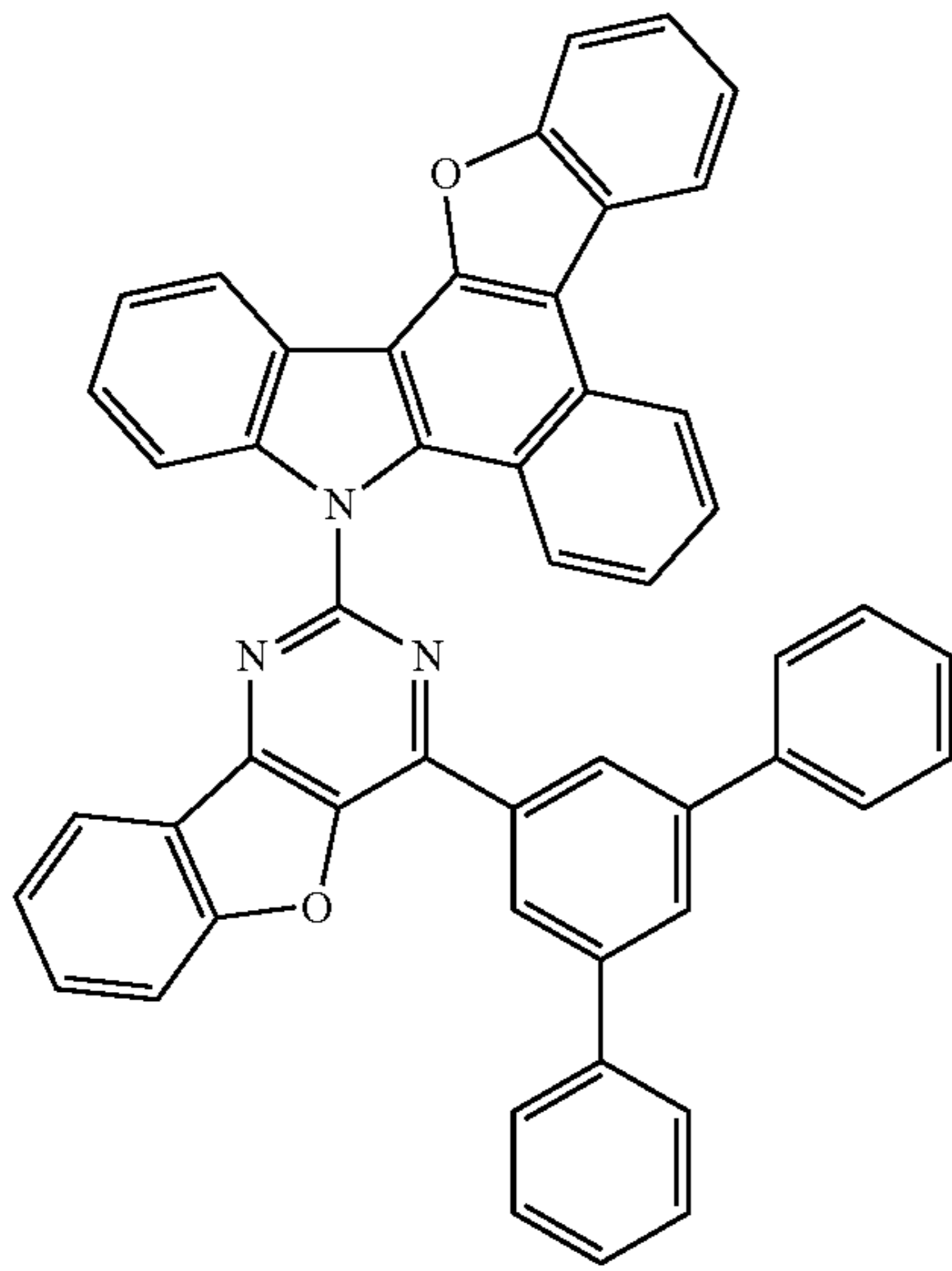
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**239**

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**240**

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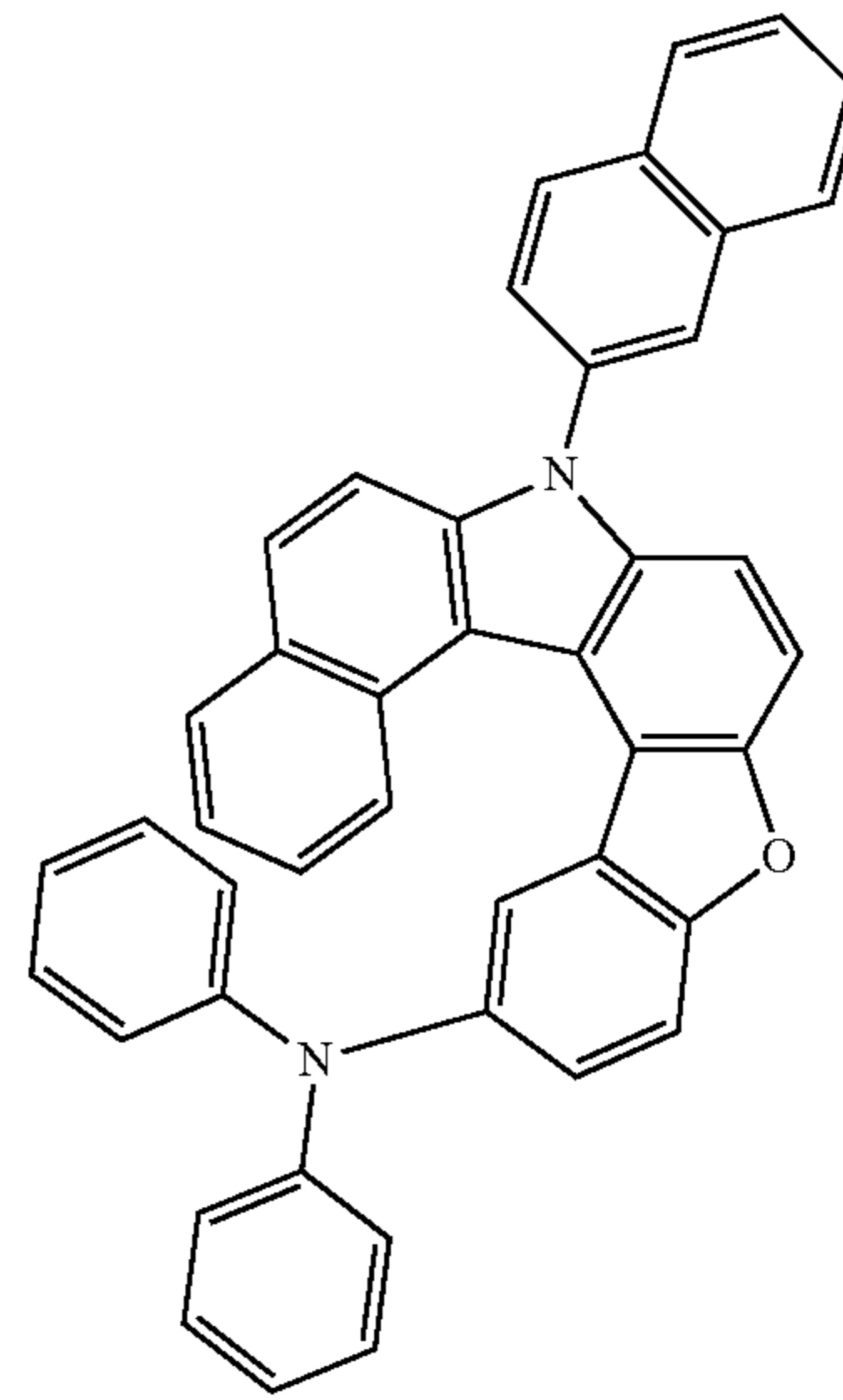
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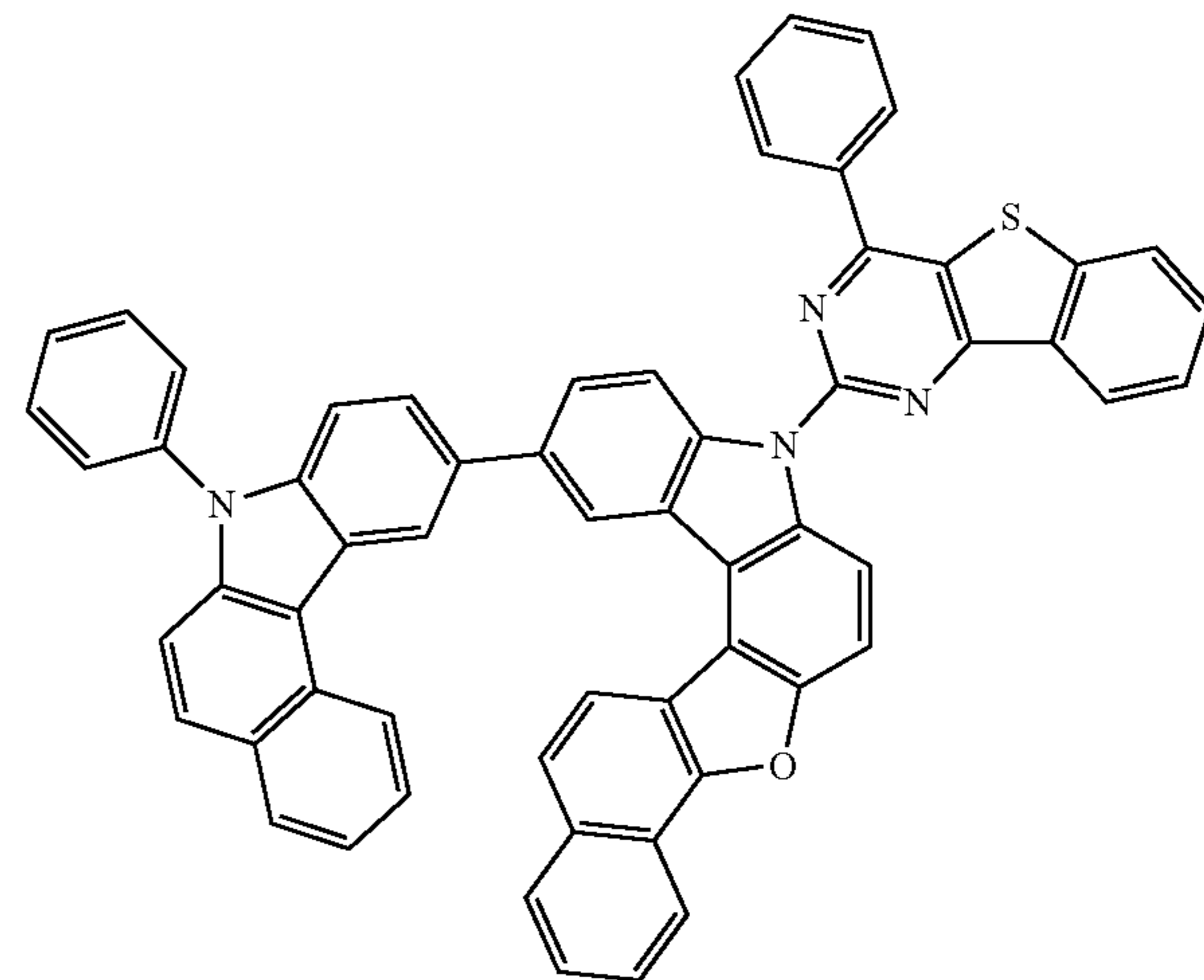
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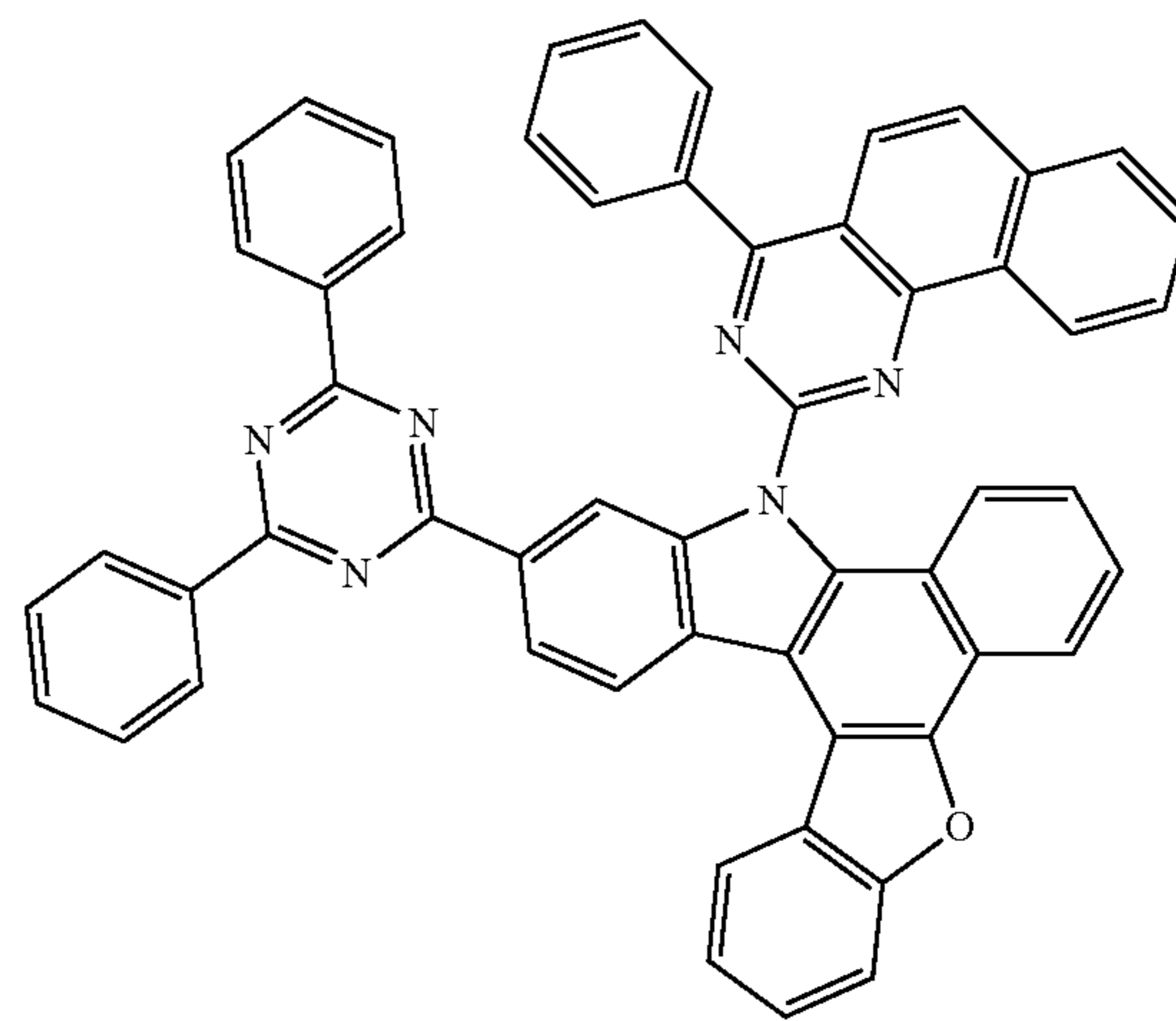
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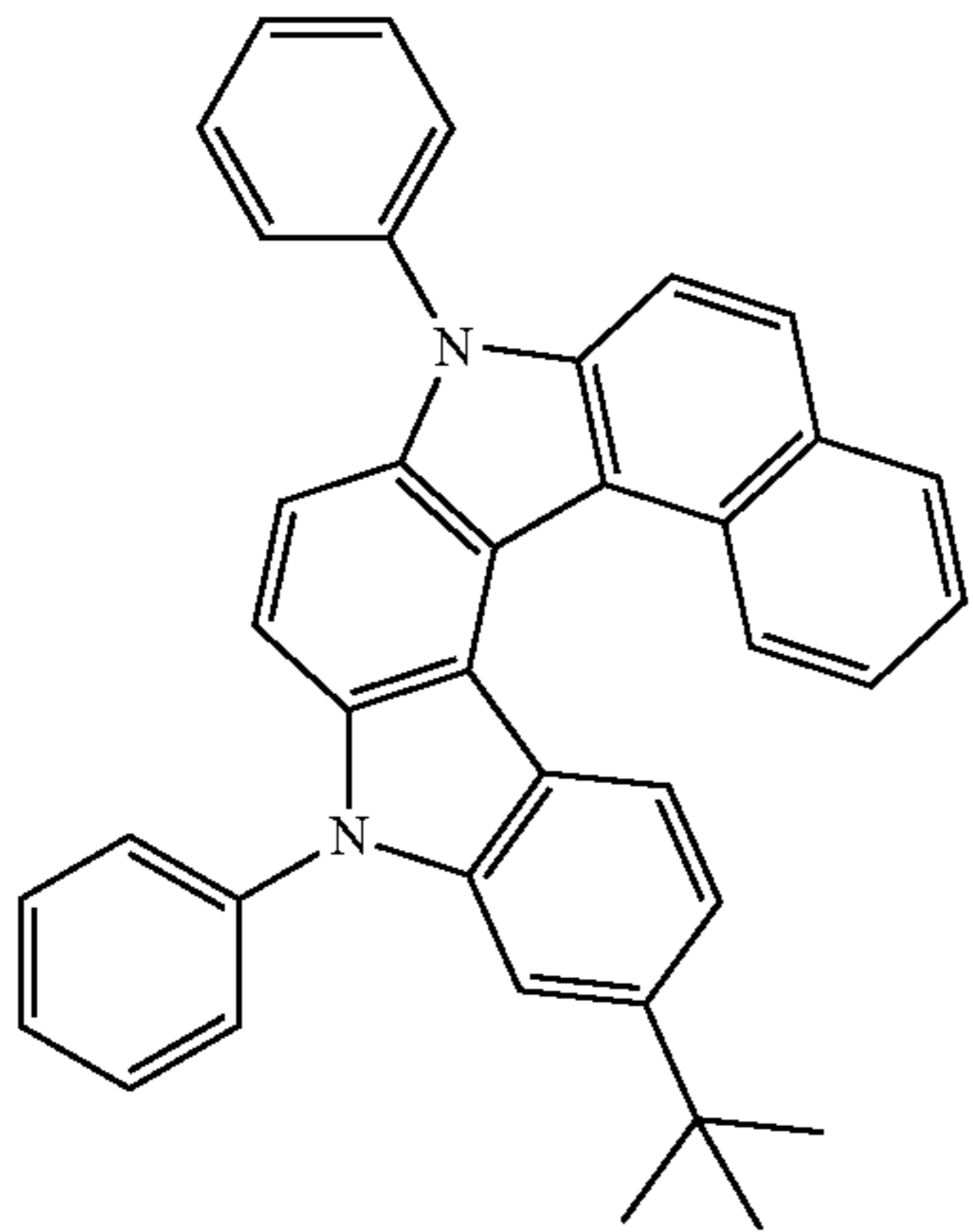
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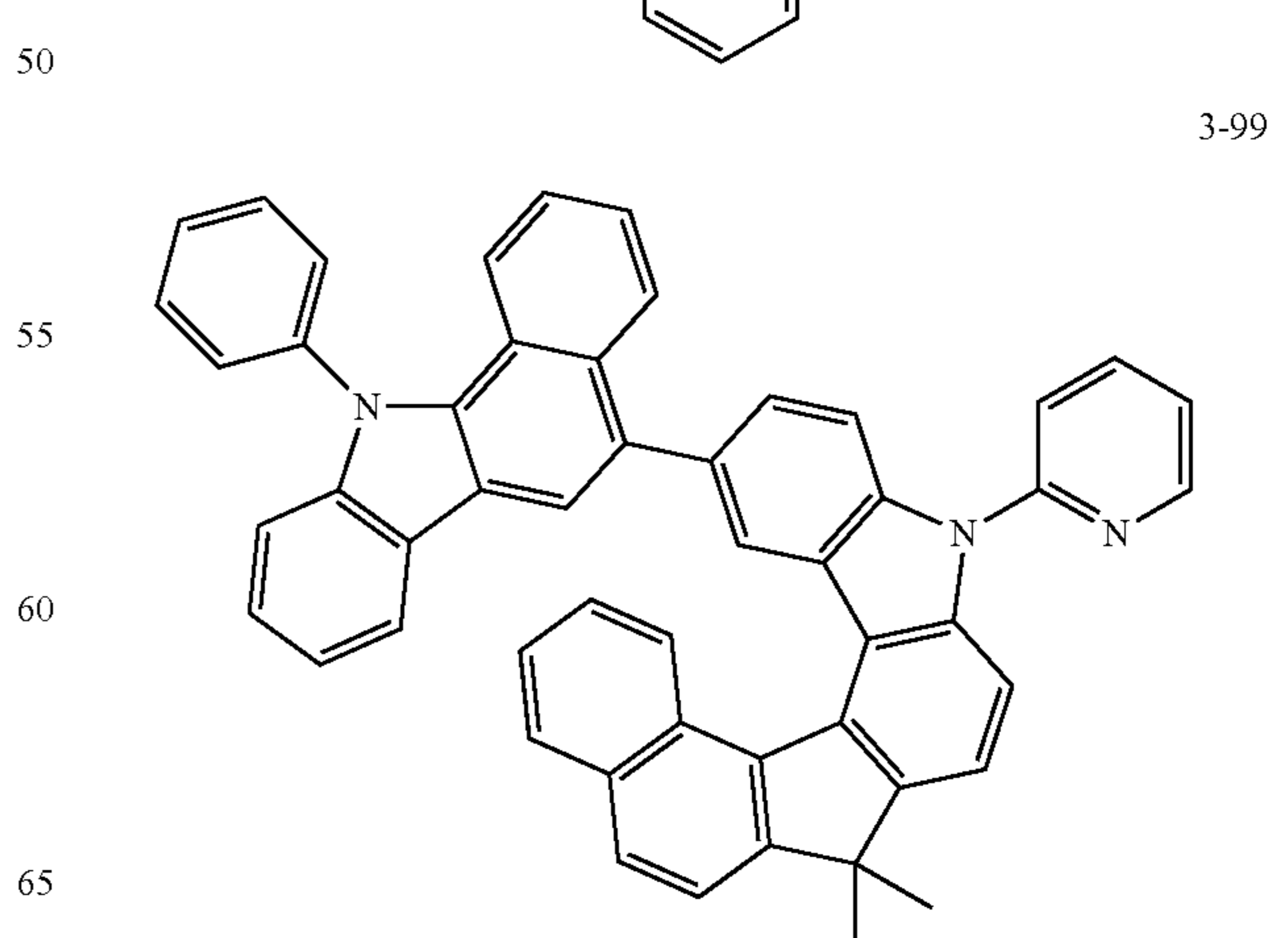
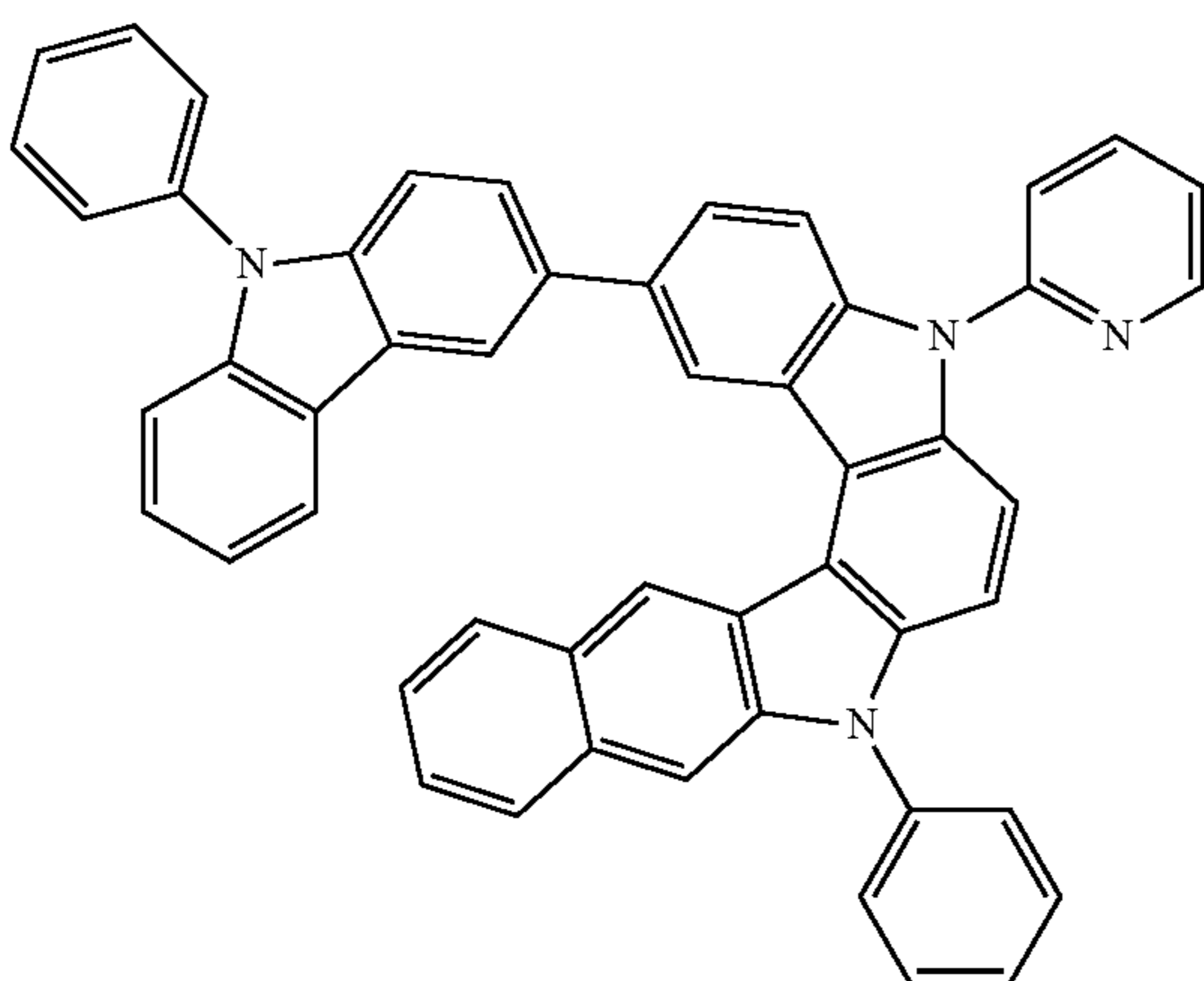
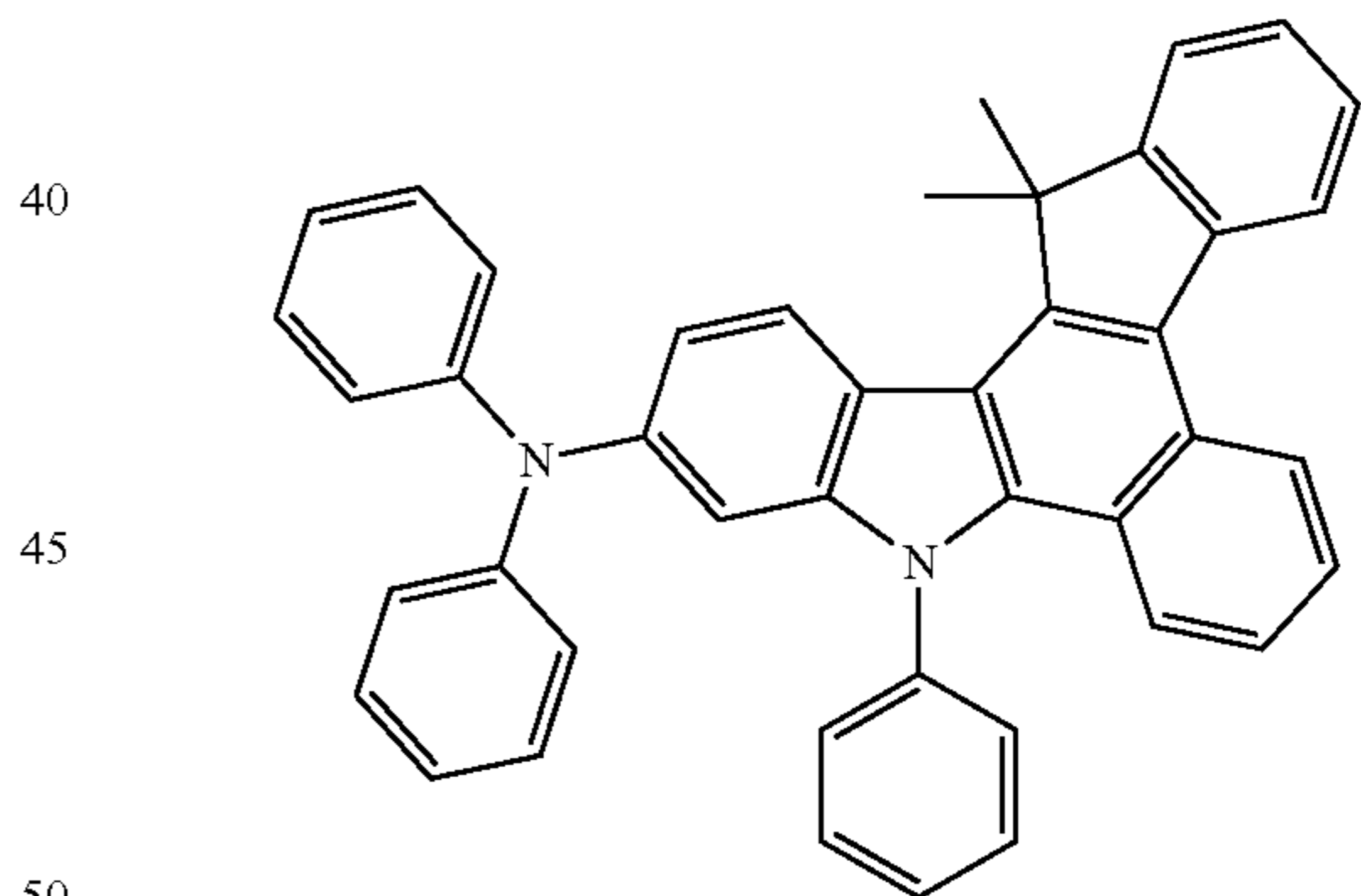
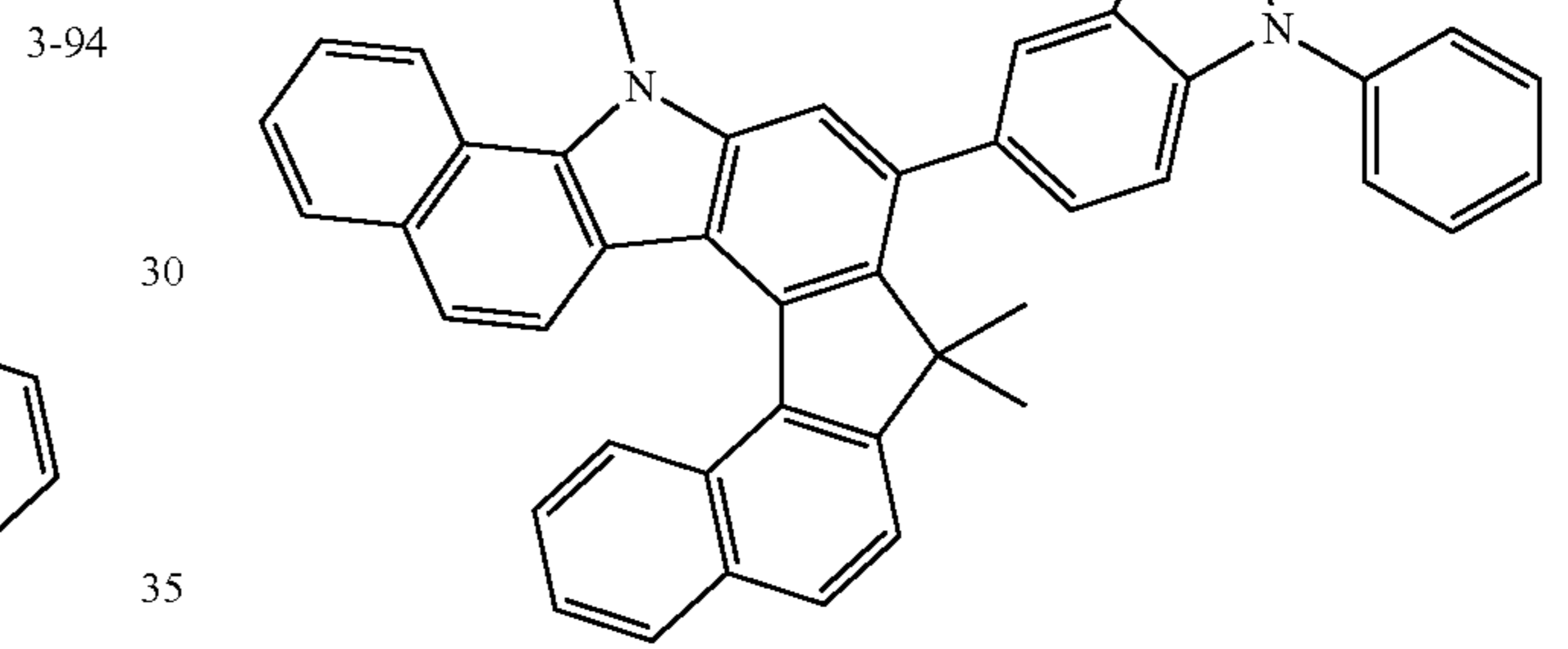
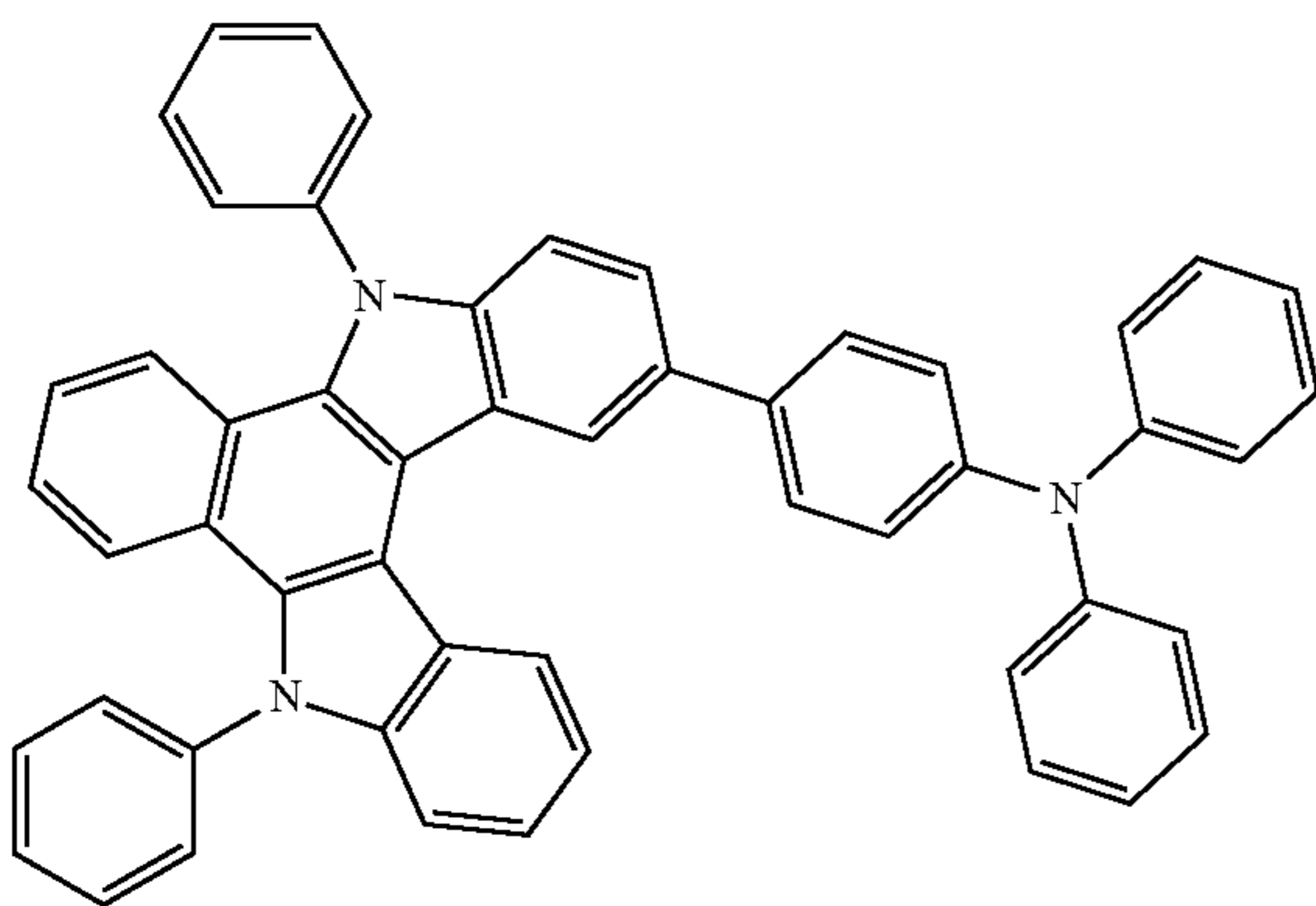
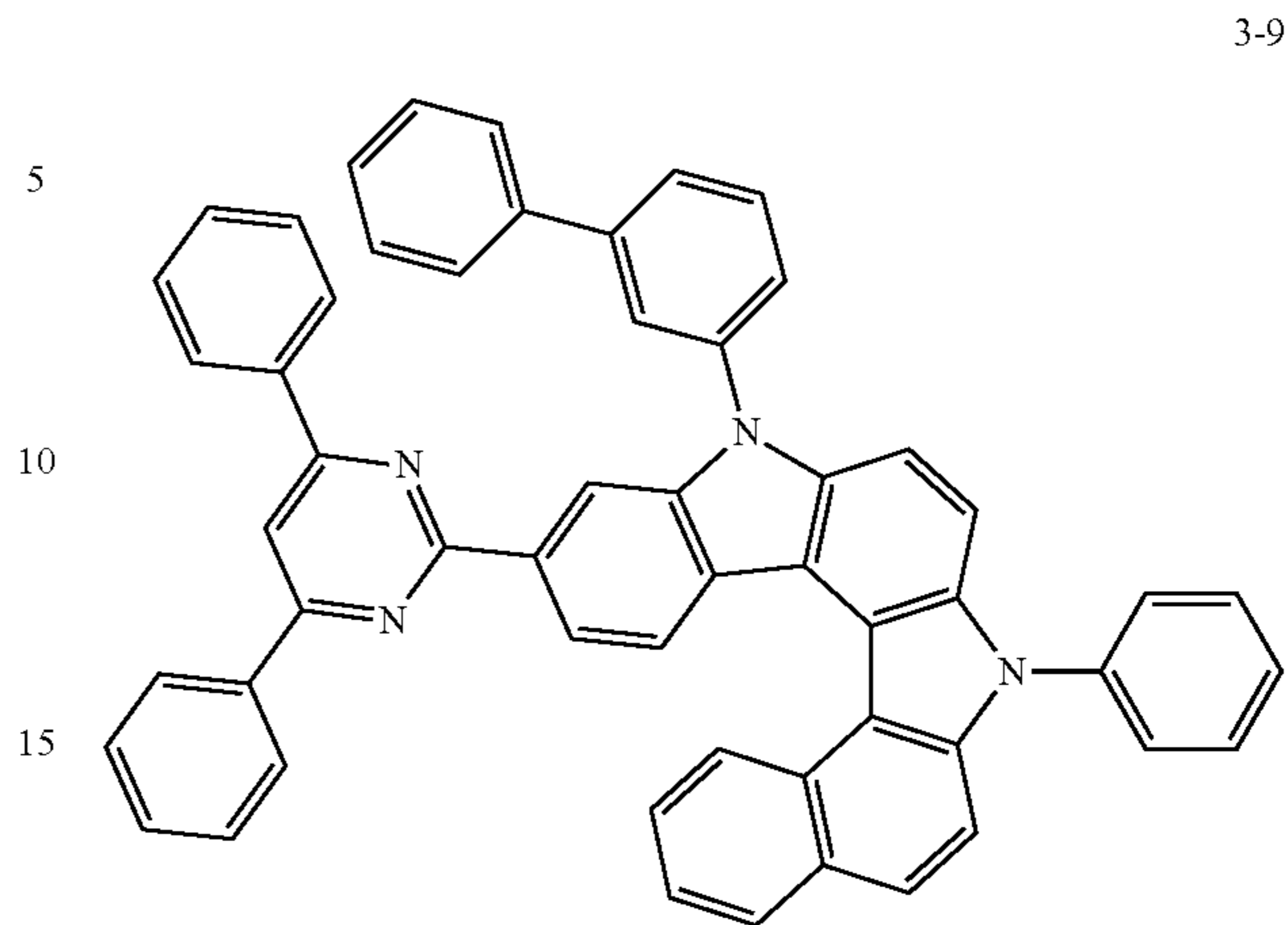
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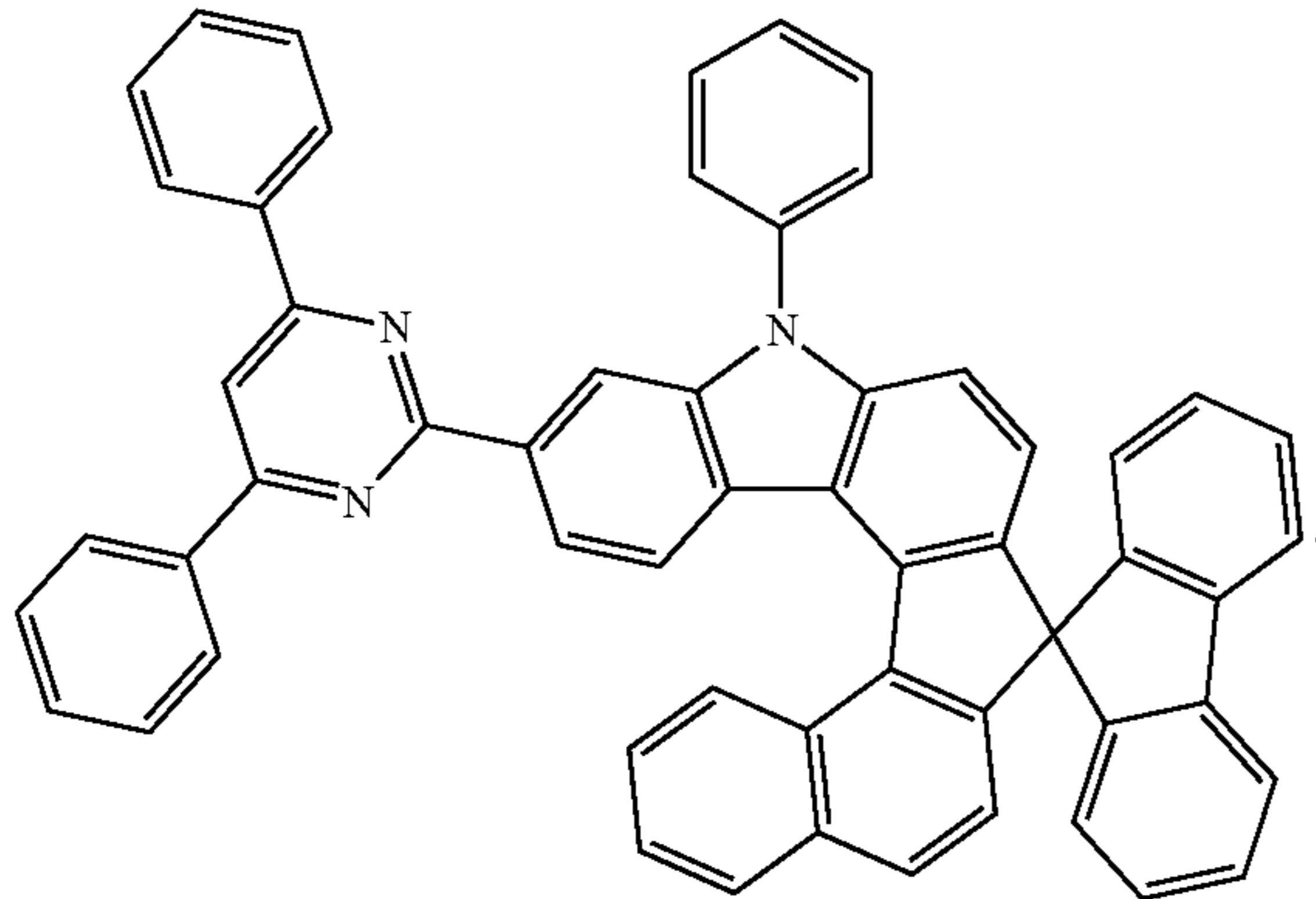
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3-100



16. The organic electric element according to claim 1, wherein the compounds represented by Formula (1) and (2)

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are mixed in a ratio of 1:9 to 9:1 to be included in the emitting layer.

17. The organic electric element according to claim 1, wherein the compound represented by Formula (1) and (2) are mixed in a ratio of 1:9 to 5:5 to be included in the emitting layer.

18. The organic electric element according to claim 1, wherein the compound represented by Formula (1) and (2) are mixed in a ratio of 2:8 or 3:7 to be included in the emitting layer.

19. An electronic device comprising a display apparatus comprising the organic electric element according to claim 1; and a driving part configured to drive the display apparatus.

20. The electronic device according to claim 19, wherein the organic electric element is an OLED, an organic solar cell, an organic photo conductor, an organic transistor, or a device for monochromic or white illumination.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

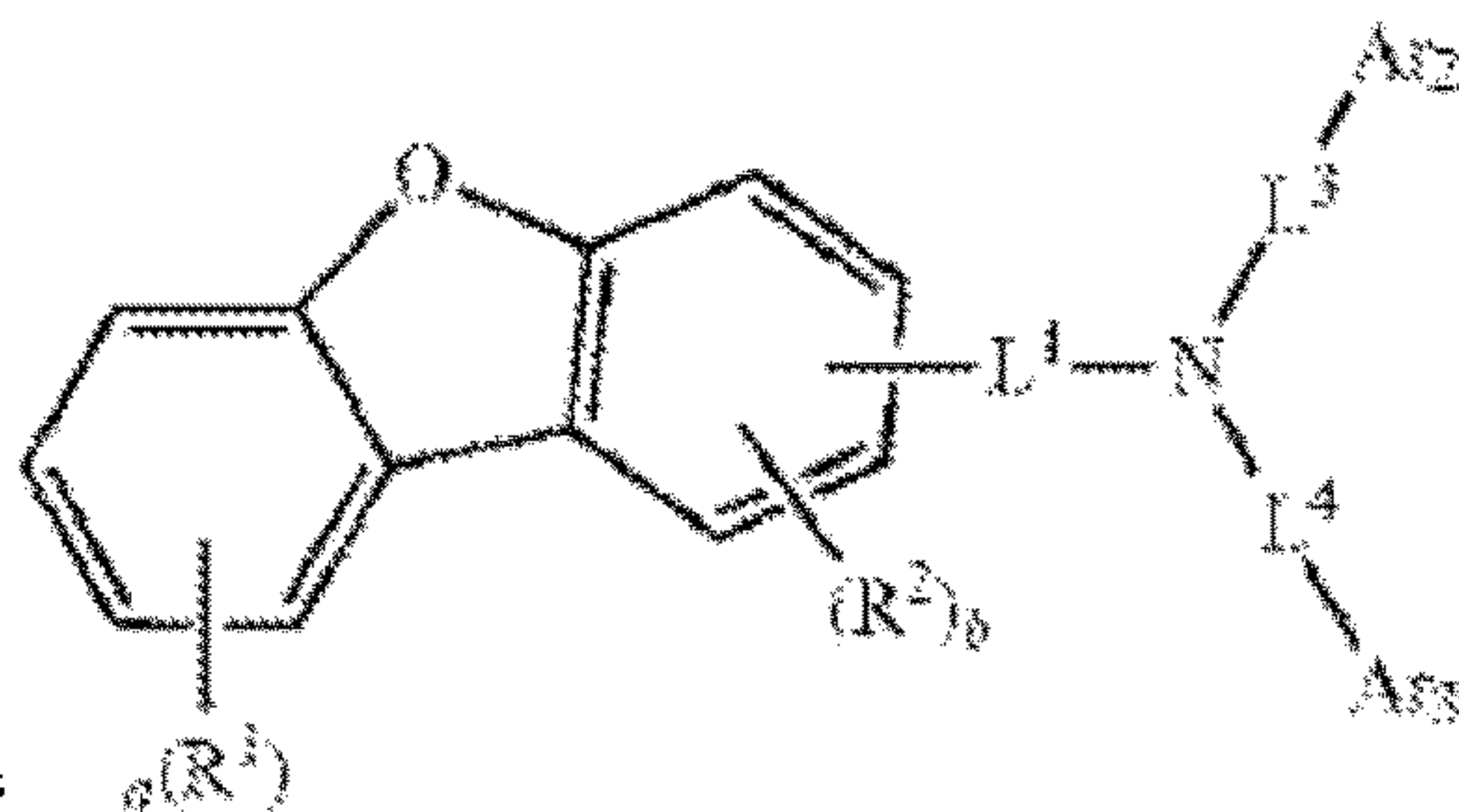
PATENT NO. : 11,024,805 B2  
APPLICATION NO. : 16/098627  
DATED : June 1, 2021  
INVENTOR(S) : Lee et al.

Page 1 of 5

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

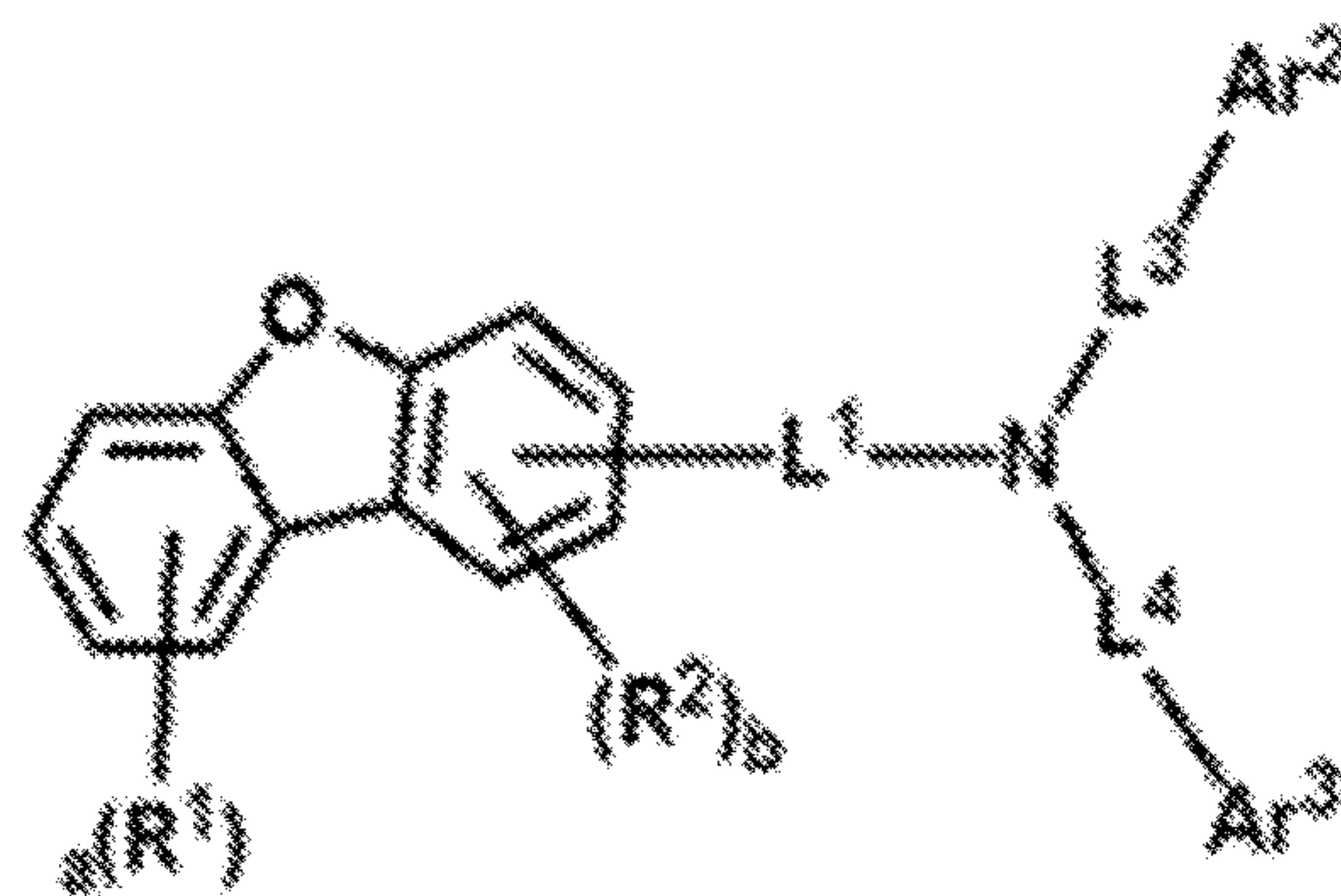
Column 175, Claim 3, Formula 12:



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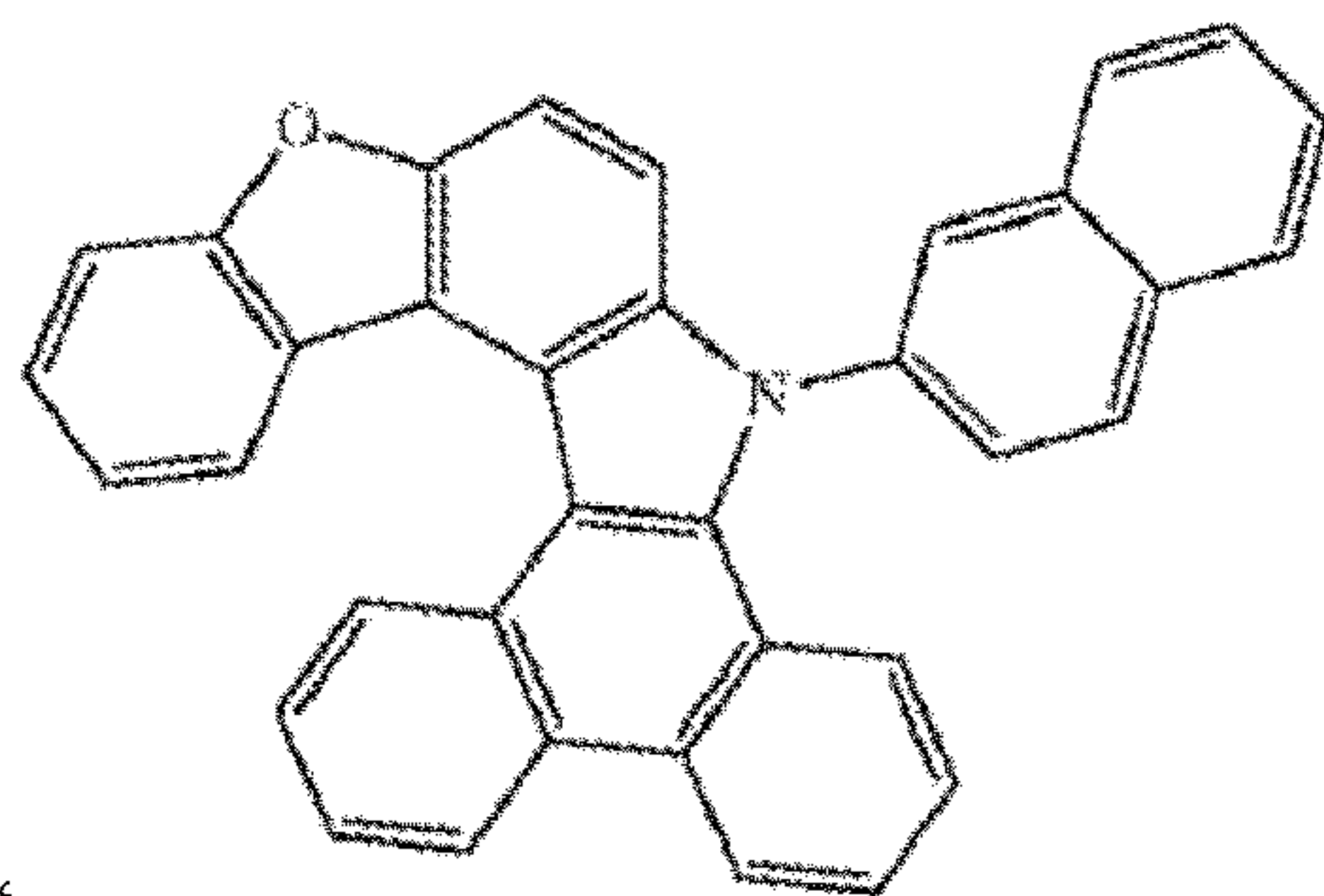
And replace with --

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Column 214, Claim 15, Formula 3-4:

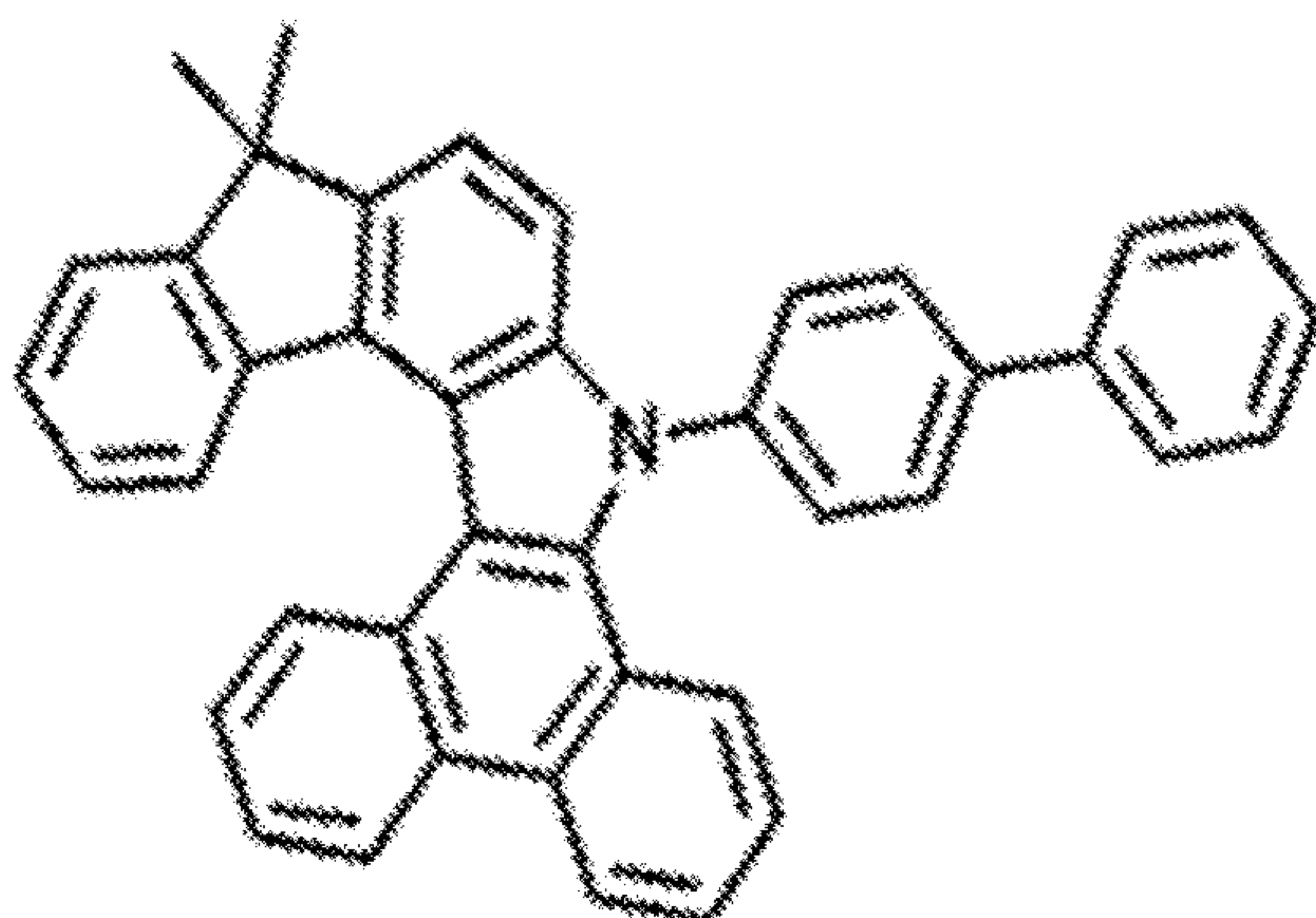
Signed and Sealed this  
Seventeenth Day of August, 2021

Drew Hirshfeld  
*Performing the Functions and Duties of the  
Under Secretary of Commerce for Intellectual Property and  
Director of the United States Patent and Trademark Office*



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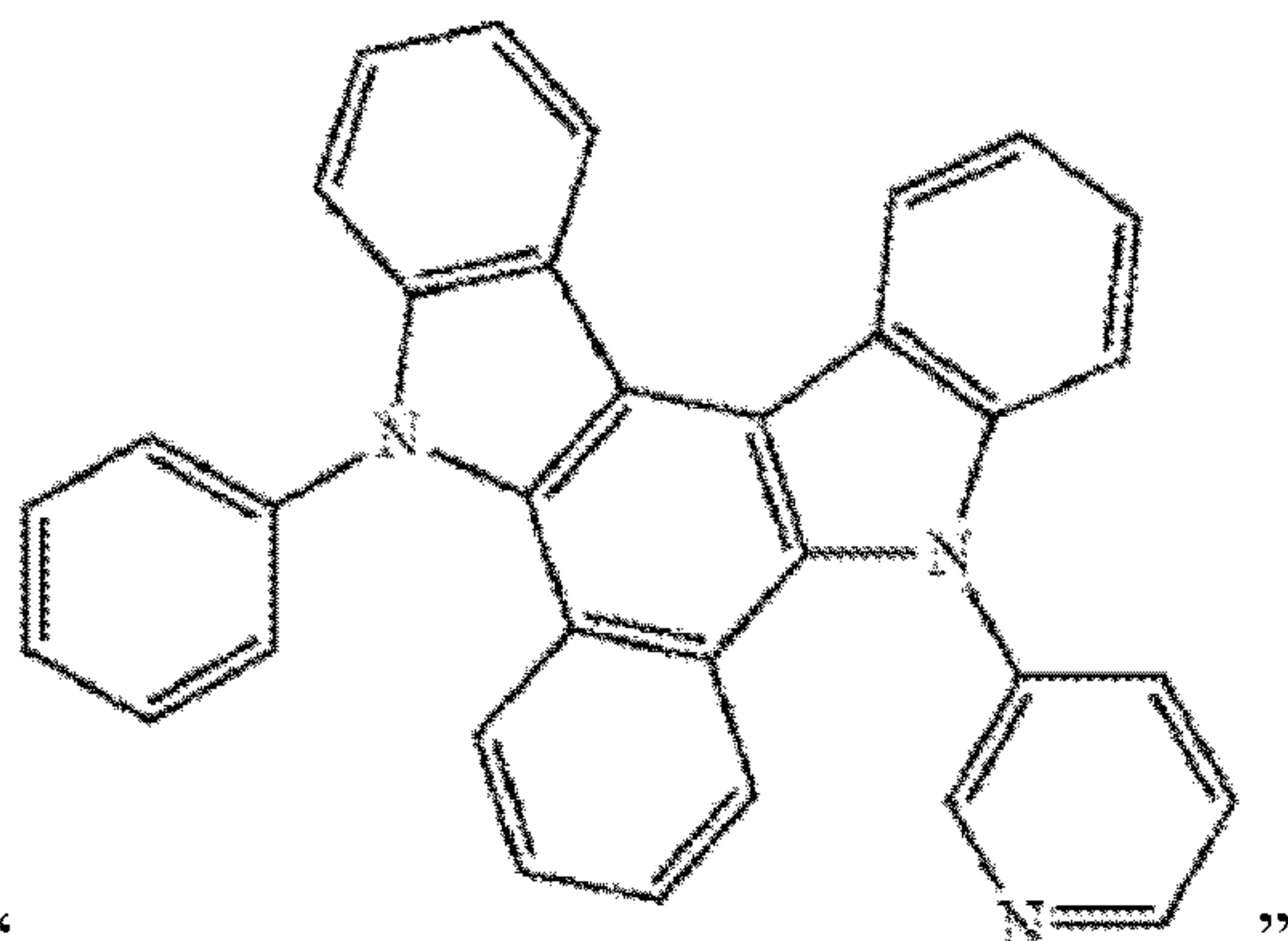
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And replace with --

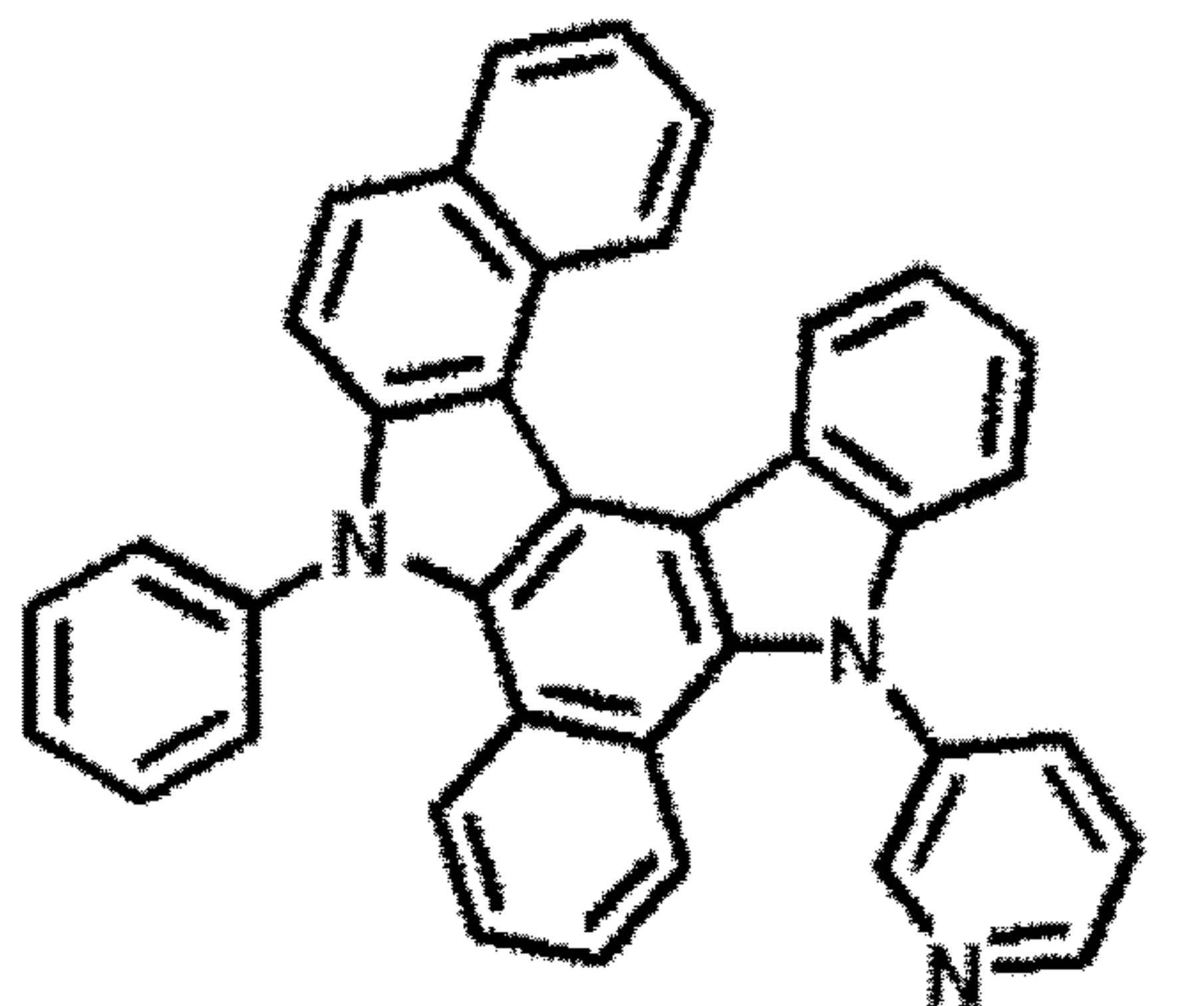
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Column 216, Claim 15, Formula 3-13:



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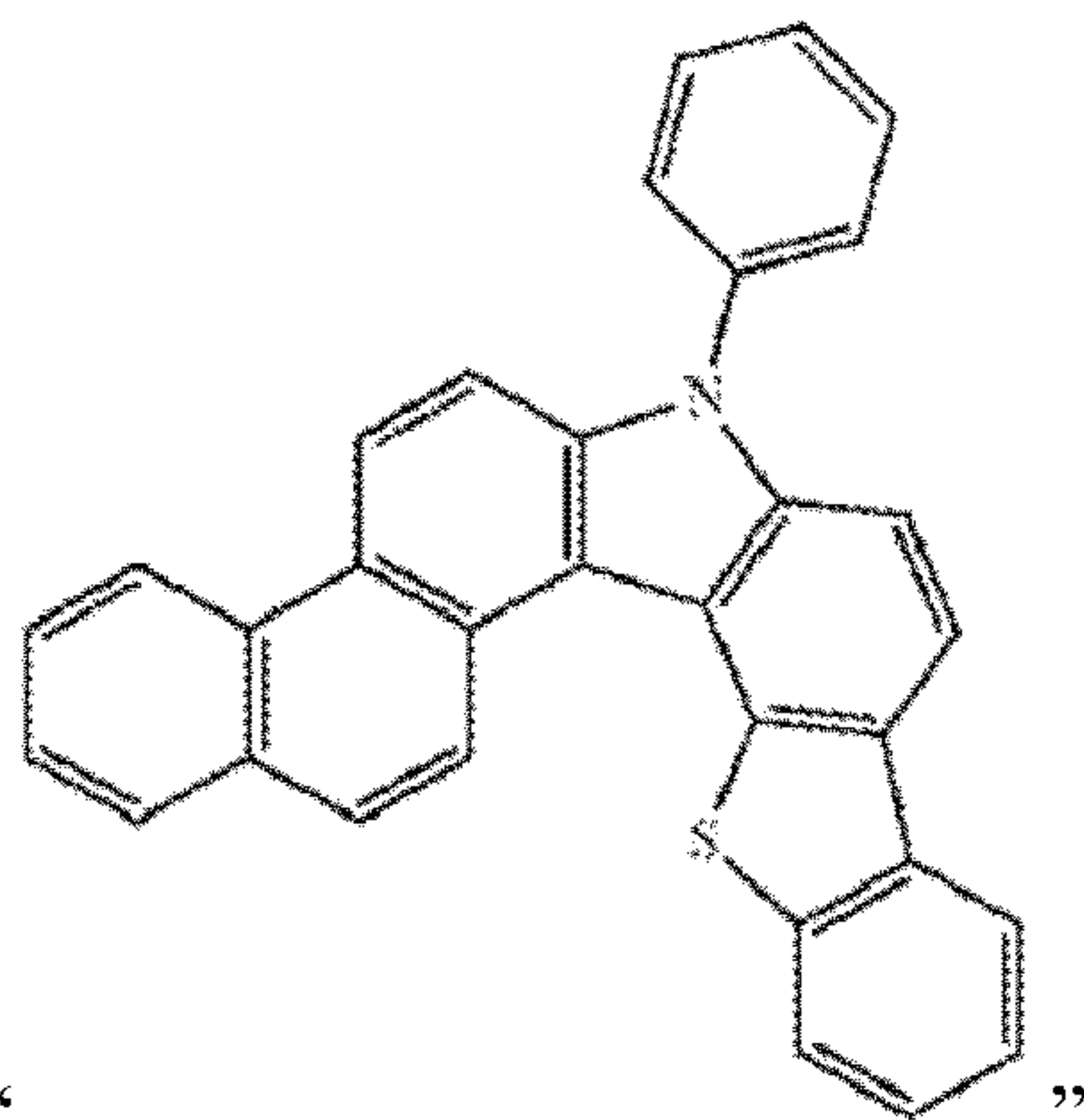
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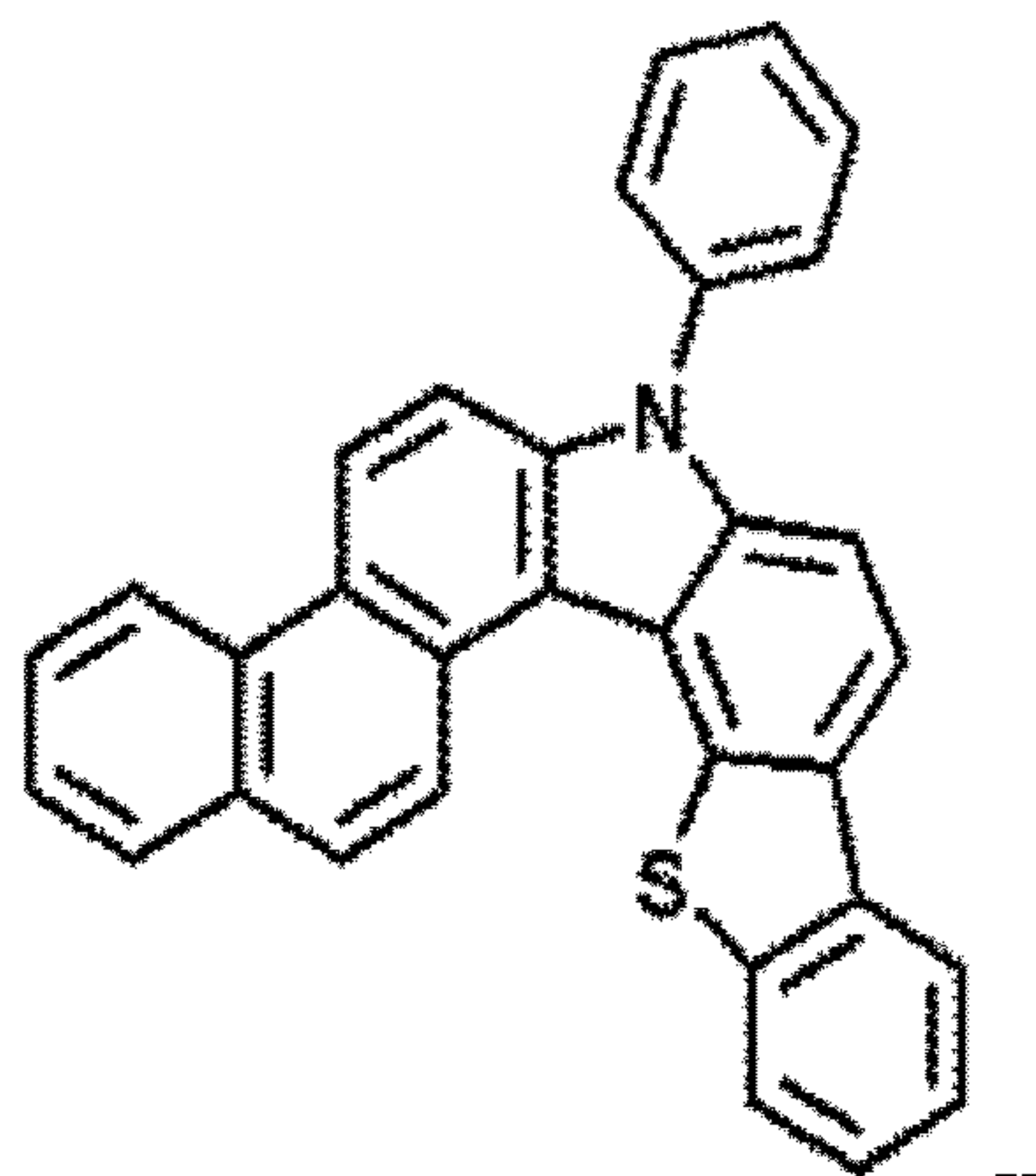
And replace with --

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Column 223, Claim 17, Formula 3-38:

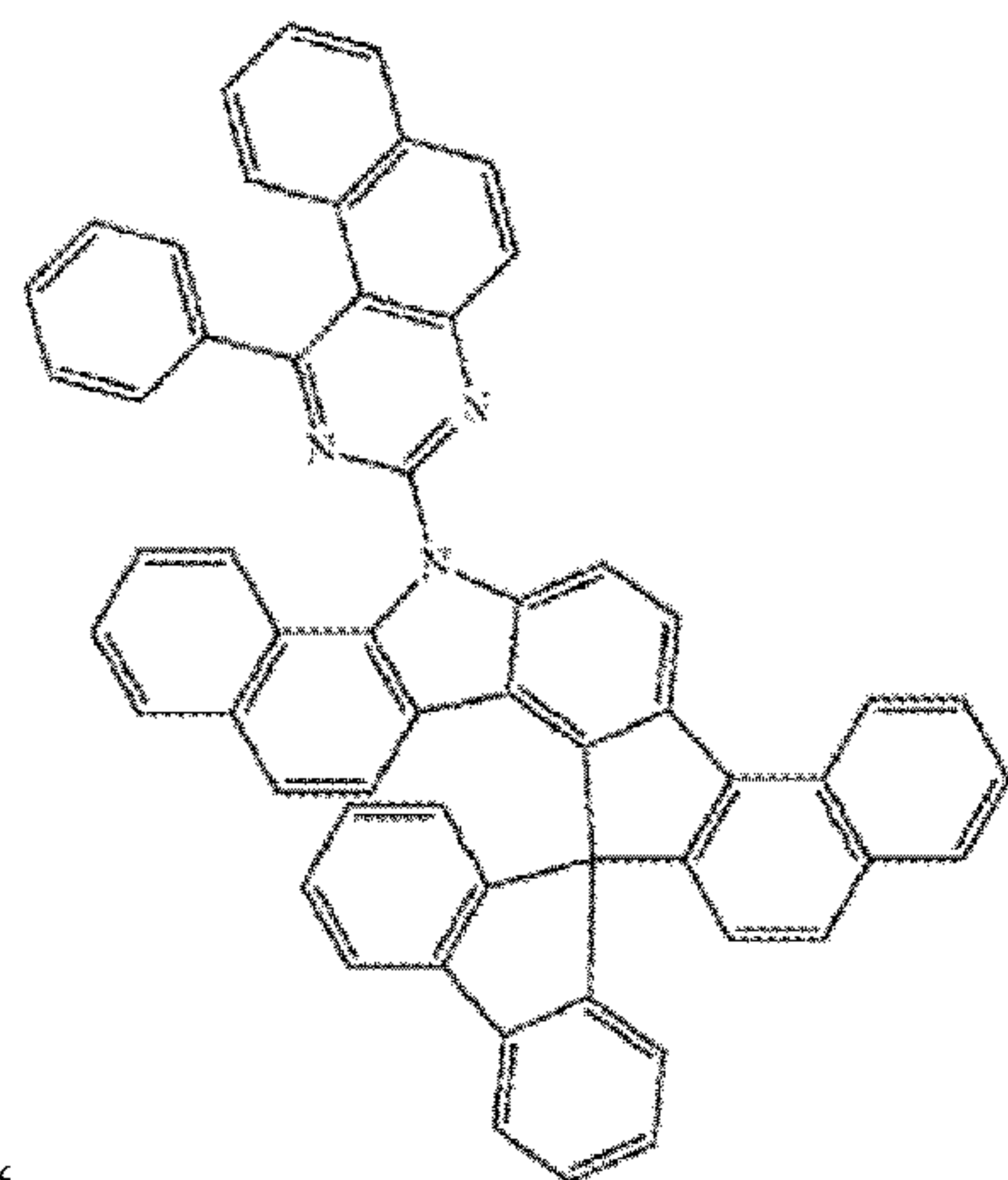


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And replace with --

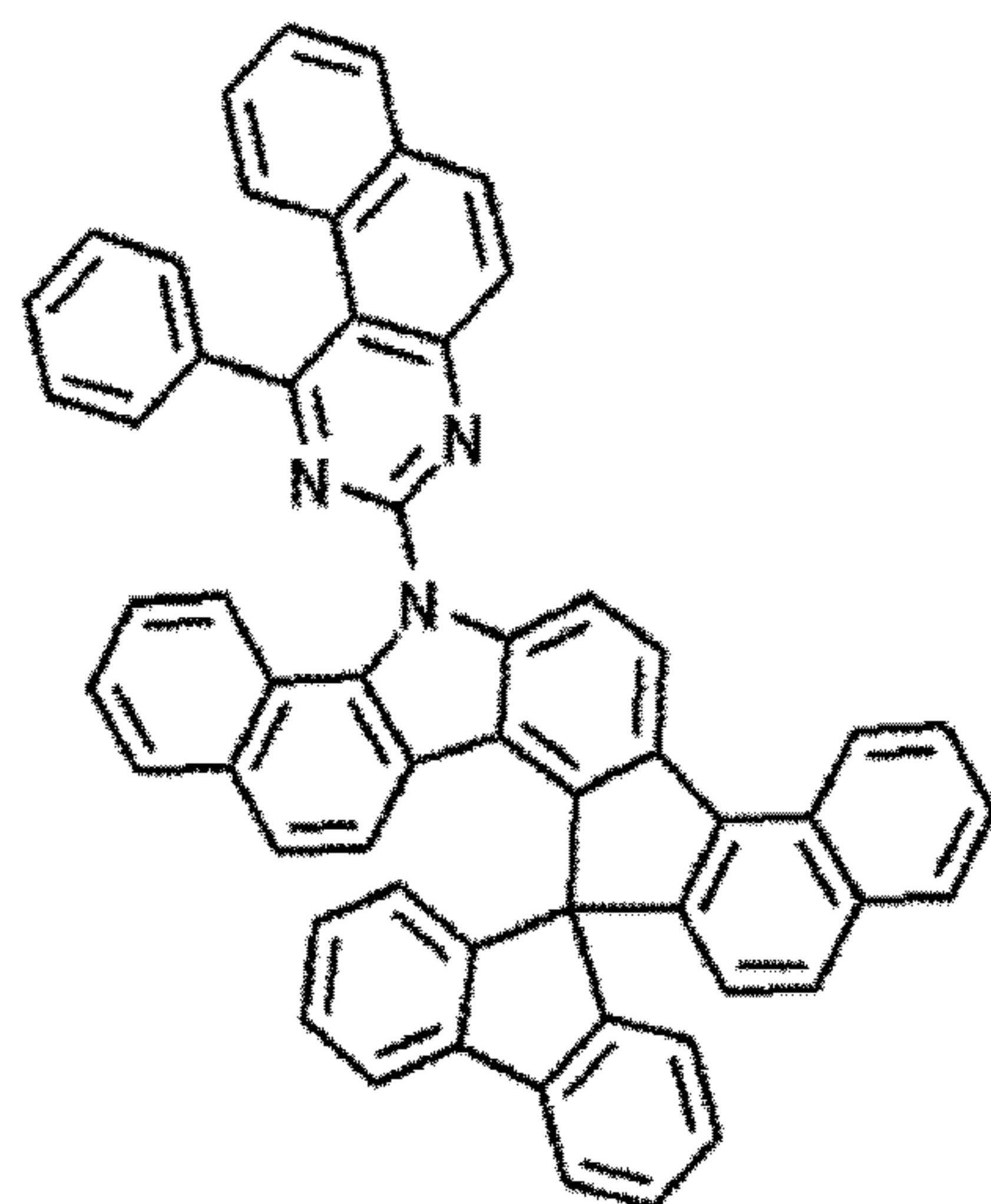
Column 226, Claim 17, Formula 3-48:



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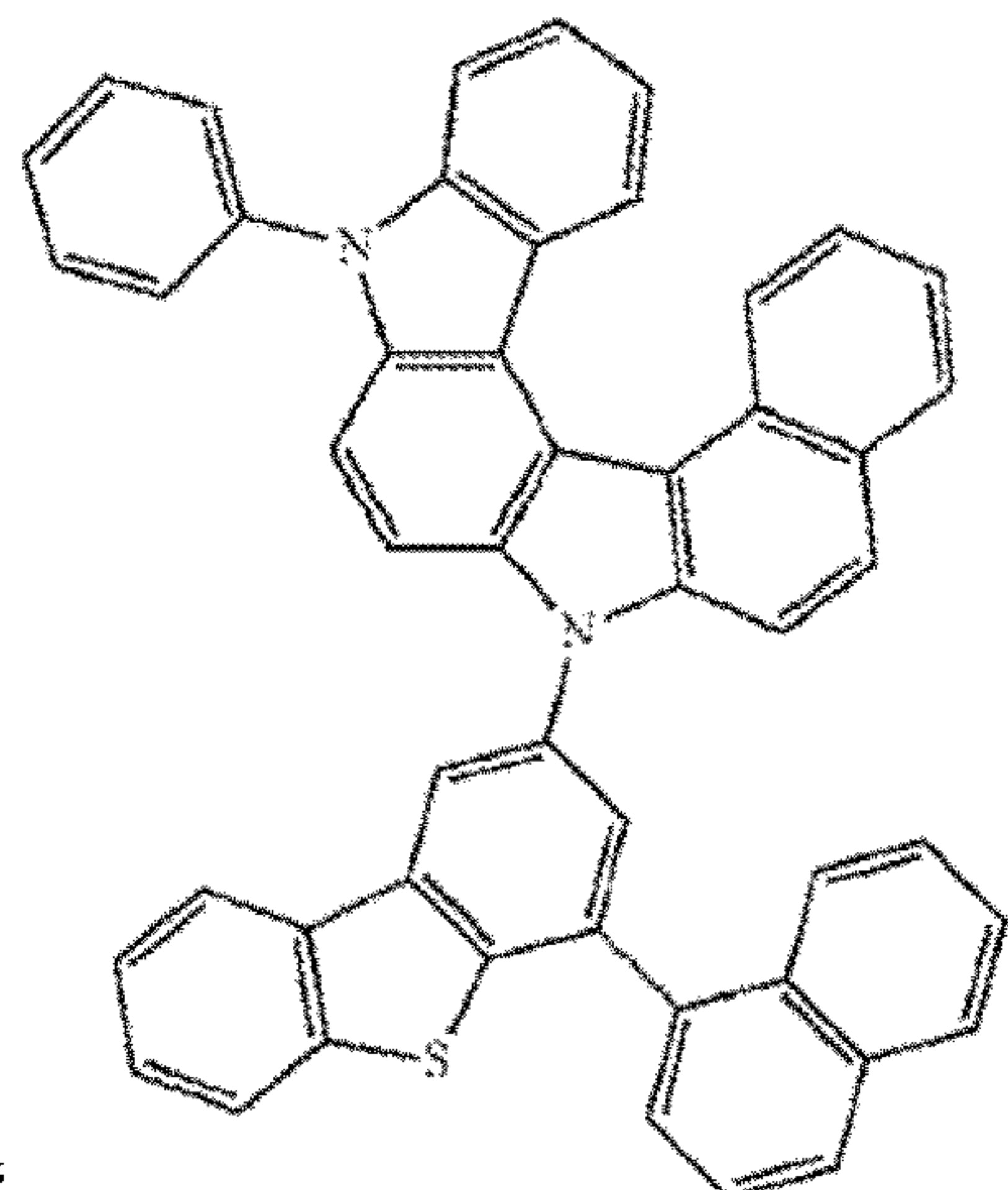




And replace with --

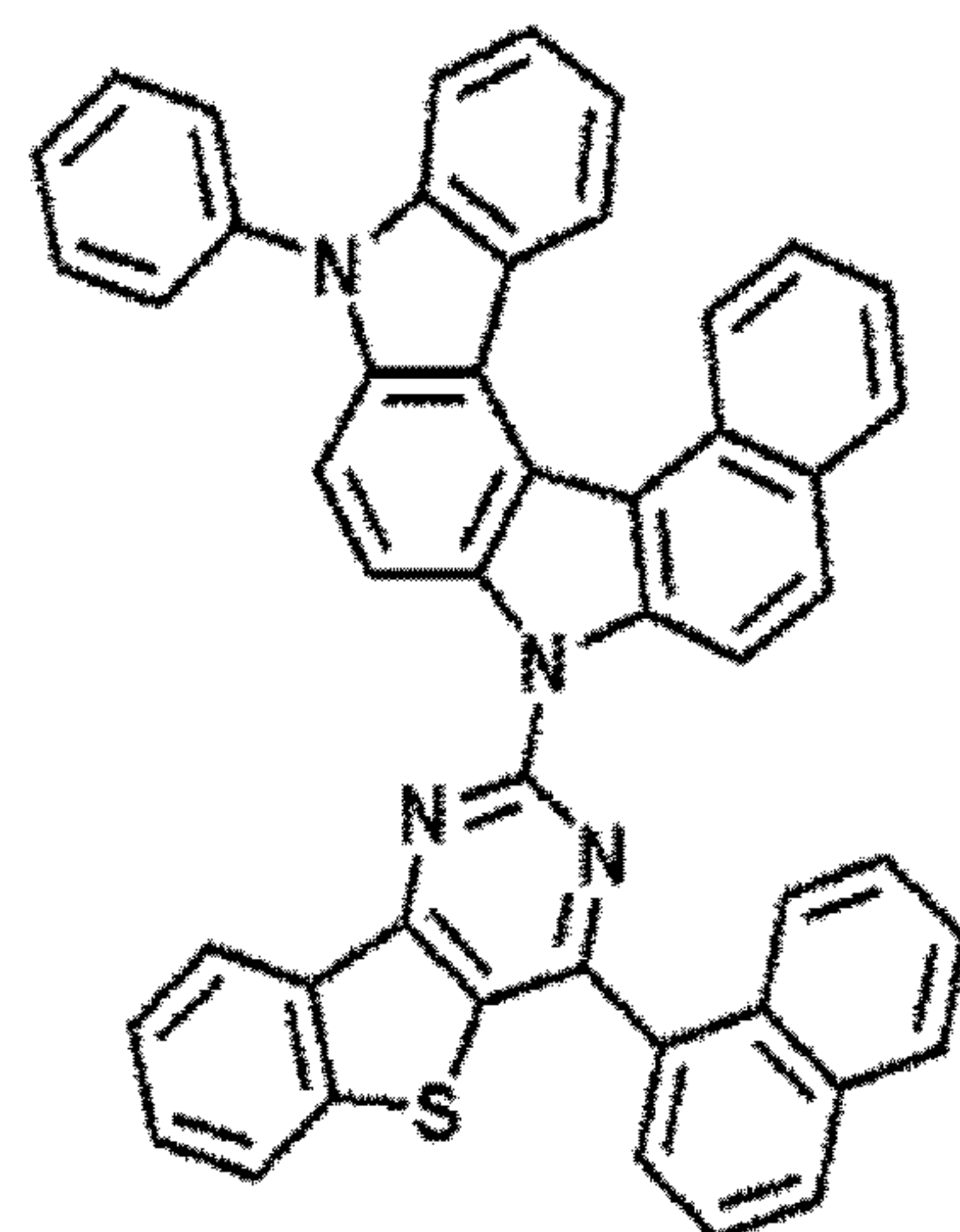
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Column 231, Claim 17, Formula 3-65:



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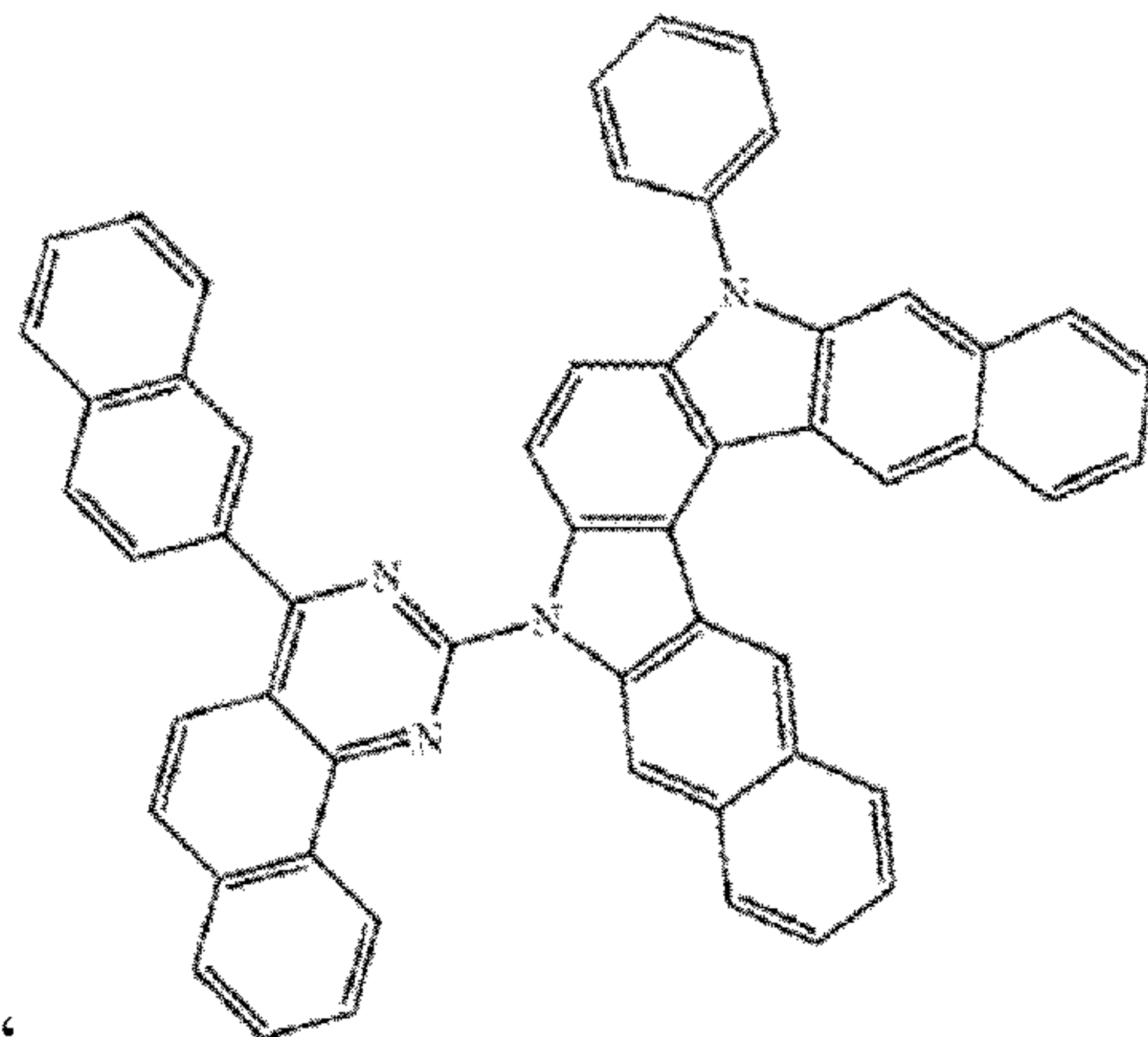


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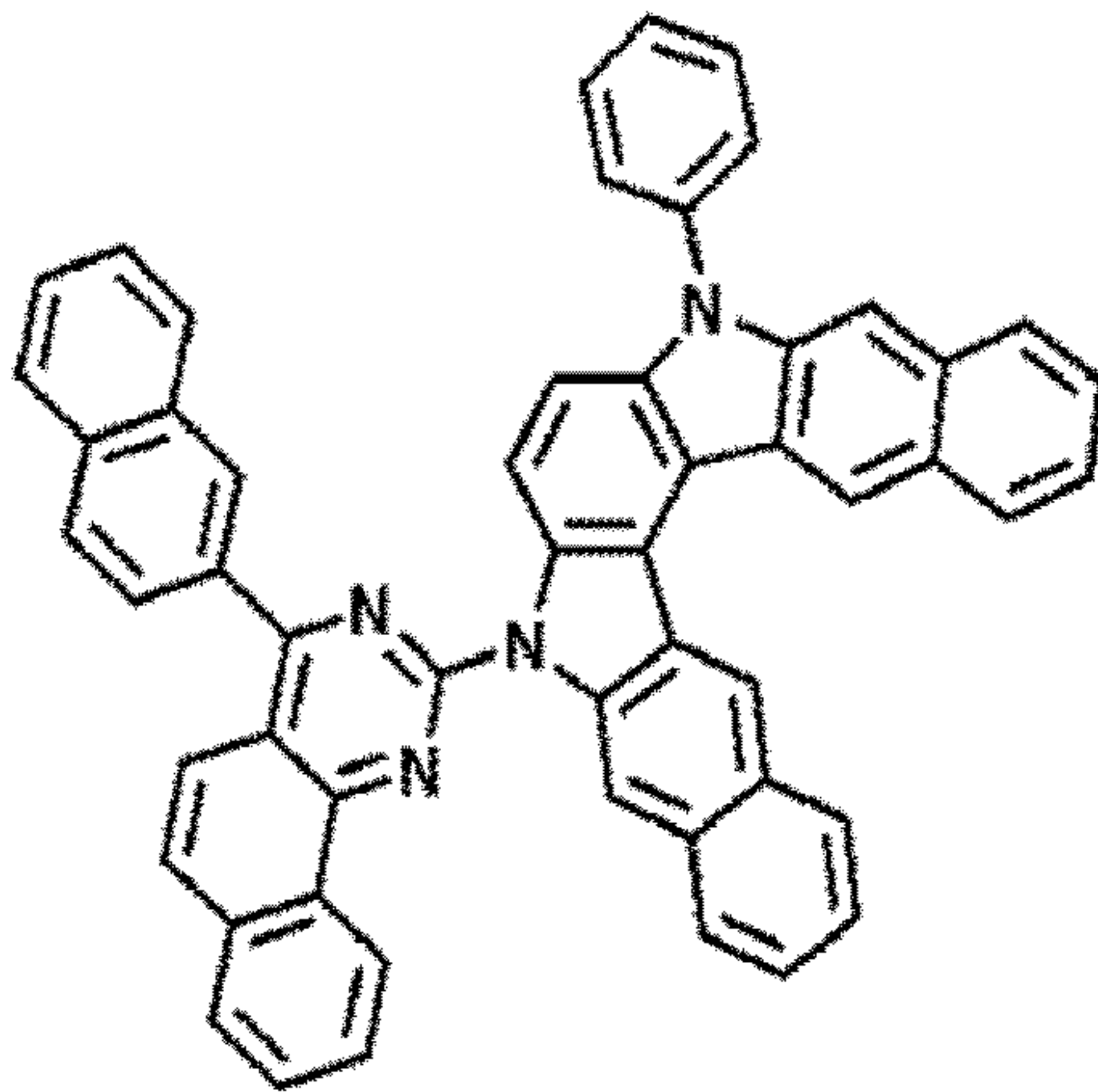
Column 233, Claim 17, Formula 3-39:

3-39



Please delete “

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**3-69**

And replace with --

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